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AUTOMATIC RAILWAY SIGNALLING.

IN another part of this issue will be found a description of the Miller system of automatic railway signalling. It is claimed to be the first practical block system placed in the cab of a locomotive, but this does not seem to be the case, as Boult's much more complete system, already described in our pages, has, we understand, been tried on the G.N. and other lines, although it is not in use regularly. The Miller block signal is a system that places a signal where the engine driver can see it regardless of weather conditions, that is, in the cab of the engine, where it cannot be obscured by fog or storm. The insulation of the track rails, also, is said to be unaffected by ice, snow or sleet, but we fail to find any statement as to what would happen if a slight landslip took place or the track became flooded, as often happens on English lines.

The track is divided into block sections. What is here meant by the word "block" is the distance between two signal-giving points. This may be of any distance. The device operates as well on long blocks as short, but in order to have a safe blocking device, the blocks must be of a safe stopping distance, according to the grades of the track. On an up-grade the blocks may be shorter than on a descending grade. How does this apply to a single line?

The engine-driver receives the indication for the second block in advance at all times. For instance, as long as two blocks in advance are clear, the white light continues to burn. When the second block in advance is obstructed the red light immediately appears. This indicates to the engine-driver that the block he is entering (which is a safe stopping distance) is clear, but the next one in advance is obstructed. He now has one full block to get his train under control before entering the obstructed block. The system is claimed to be superior to the present outside signal (in addition to the lights being placed in the cab of the engine, where they are never obstructed from view), in the fact that "we need not absolutely stop the traffic until we slow-up to the obstruction."

The Miller Syndicate contends that what railroads are lacking in is a signalling device whereby they can keep the traffic moving and as closely together as possible, and do it with safety. With the present outside system of signalling, when the engine-driver comes to a block set at danger, his instructions are not to pass it until a certain time has elapsed (as a matter of fact there is no time *limit* in the English system for *ordinary working*) or the block comes to "clear." "Experience has taught us," say the Miller people, that, on "a heavy traffic road, in stopping one train you are stopping the whole line of traffic where it is heavy. With us, we say to the engine-driver, 'After you receive the danger-signal, you pass over a safe stopping-distance before entering the obstructed block, and you should enter this block with your train under perfect control and at your

command, so that you can easily stop when you come within vision-distance of the obstruction.' He enters the obstructed block with his train under full control. He does not pass any outside signal whereby there is a possibility of his forgetting what the position of the semaphore was when he left it, but carries with him through the entire block, or until he comes upon the obstruction, the indication that is given him at the entrance of the block." All switches, fouling-points, passing tracks, derails, open bridges, are said to be protected by this system.

Its advocates contend that on the point of economy it can very readily be seen that with this system the main track switch-lights may all be dispensed with, with safety, for this reason: that they indicate to the engine-driver at the second block in advance the position of all switches. If the switch is closed and set for the main track, the engine-driver receives a white light in the cab of the engine, instead of waiting to get the indication when he comes within vision-distance of the switch, which is indicated to him at the present time by an oil lamp, showing the different colours. In fogs and storms it is absolutely impossible for an engine-driver to see these outside switch-lights. The advantage of the Miller system under these circumstances is therefore claimed as being very apparent.

Should a car during a heavy storm be blown from a siding so as to obstruct the main track, then the car instantly indicates the danger to the engine-driver of an approaching train, giving him the "danger" signal at the second block in advance. By its use the fog problem is thought to be completely solved.

The Miller signal can, of course, be worked in conjunction with any existing signal system. Indeed, it is only as an auxiliary, and this, we believe, is fully recognised by the Syndicate's technical advisers, that we can see any outlook at the present time for the system, as it does not conform to our Board of Trade requirements. Our attitude towards the system is not one of hostility but rather of searching inquiry. Personally, we should be glad to think it stood a chance of being employed on English lines, and it will not be for the want of energy on the part of the business-like syndicate, or of skill on the part of its engineers, if it fails to obtain a foothold in this country. But British methods of maintaining a space interval between trains and the American plan of trusting to a time interval—long ago abandoned here—are entirely at variance.

There is no novelty in the proposal to substitute for the line semaphore signal a miniature semaphore or other suitable indicator on the locomotive, and in some quarters it has doubtless been felt for many years that if such an arrangement could be made, it would possess many advantages over our present system for ordinary working, and would eliminate one of the difficulties which has not yet been satisfactorily met in operating a fixed signal, which can be clearly seen by a driver, by the weak current of a track circuit. The problem is a difficult one, and we fear the "Miller" scheme has not solved it. An incandescent lamp will be a very poor signal on a bright summer day, and we should anticipate difficulty with a delicate relay placed on locomotives.

Moreover, when a driver gets a danger signal he proceeds until he comes within "vision distance of the obstruction," and if, in the dark, or in a fog, he strikes the obstruction, it is hardly a system of working which will be tolerated.

Furthermore, it appears to us to be an adaptation of the "Hall" system—a system that has been in use on American railways for many years—the difference being that the Miller people put certain apparatus on the locomotive, and dispense with line signals.

There is, we think, an inclination on the part of railway companies, and there certainly is on the part of the Board of Trade, to make use of automatic signalling where it can be shown to be of advantage. Railway companies would welcome it, as a lever, to counteract the growing demands of the signalmen; the Board of Trade, perhaps, because it is thought to be the thing.

There are, however, difficulties of a very practical nature which, on certain lines, cannot be overcome. On what may be regarded as passenger lines, the opportunities are greater than on lines in the manufacturing districts. In the latter, the lines abound in traders' sidings, and wherever shunting has to be done a signalman must be kept to operate the points. The B. of T. would never allow points to be worked without visual signals, which must, of course, be interlocked. Some time ago the question was entered into with respect to one of our largest railways, and it transpired that at only some 20—less than 30—boxes could men be dispensed with if automatic signalling could be satisfactorily introduced. It was not thought worth doing.

As to the system, of course, "the proof of the pudding is in the eating," but we do not think any railway company, nor the Board of Trade, would be found willing to place confidence in any system relying upon a signal confined to the cab of the engine. Nor do we think they would put a signal there for the guidance of the driver. If they did so, simply as an adjunct, it would form a reasonable excuse for the driver to say he was guided by it, supposing anything went wrong. To dispense with visual (line) signals is to place the entire responsibility on the apparatus on the engine, and to limit confirmation or contradiction to the driver and his mate, for if anything went wrong, the electrical instruments on the engine would assuredly be knocked to pieces.

We do not know what experience the inventors have of the power of a carbon filament to stand the rough motion of a locomotive. Assume the filament of the red light breaking, stoppages must arise. Add to this the many possibilities, such as a break-down of auxiliary engine and dynamo, the failure of batteries, broken circuits and bad contacts, and take into consideration the British climate, the chances of relays going wrong, &c., and we fear there is not a great chance of the adoption of such a scheme. Breaks, or any disarrangement of the device, will certainly indicate stop, but we may have too many stops, which, with our present system, need never occur.

On the general question of the use of electrical apparatus for such purposes, we can only say that if the usual practice of the telegraph engineer is followed in the design of the apparatus, and general execution of the work, failure is bound to occur. Outdoor signals we take to be a necessity. To repeat these on the engine is to introduce a vicious principle which will some day lead to mischief. The day is rapidly approaching when railway companies will be able to command electric power to work both signals and points, and it is in that direction that we look for improvement.

It is, of course, a matter of the greatest importance that every precaution should be taken to ensure that railway travelling is absolutely safe—indeed, it is well known that a person is infinitely less liable to accident when travelling on an English railway than while walking through the streets of London—and fortunately, the security of passengers is in this country carefully studied in every detail by our railway managers.

Whatever may be said of the management of British railways, it must be admitted that in regard to safety they leave little to be desired from a passenger's point of view.

At the meeting of the Great Eastern Co., Lord Claud Hamilton gave the following interesting figures as to accidents in the year ending June, 1901 :—

	United States.	United Kingdom.
Passengers killed	... 1 in 2,129 382	... 1 in 7,432,120
„ injured	... 1 in 120,386	... 1 in 415,672
Employés killed	... 1 in 400	... 1 in 1,019
„ injured	... 1 in 26	... 1 in 39

The chairman of the London & South-Western, dealing with the same subject, took a different period, viz., the year ending December 31st, 1901, and claimed that in those 12 months not a single passenger was killed in this country during his journeys, against 249 in the United States ; while only 476 passengers were injured in the United Kingdom, against 4,128 injured in the United States in the same period.

There is little doubt that the greater proportion of accidents to trains in the United States can be attributed to the almost general absence of block working, as we understand it, on the railways.

Finally, we would call attention to an article in this issue "Fixed Signals on Line Side *v.* Signals carried on Locomotives," evidently based on a description of the Miller system which recently appeared in the New York *Electrical World*.

Carbides in the Earth's Crust.

MM. Sabatier and Sendereus have recently contributed to the French Academie des Sciences a paper upon the synthetic production of petroleum, which incidentally gives evidence of the existence of carbides of the alkaline earth metals in the earth's crust. (*Comptes Rendus* 134, pp. 1185-1188.)

The interest of this investigation for electro-metallurgists lies in the fact that calcium carbide is an industrial product of the electric furnace, and that the research of MM. Sabatier and Sendereus shows that a manufactory for the production of petroleum is not outside the bounds of possibility. The authors of this paper summarise their experiments and results as follows :—When using a mixture of acetylene gas and hydrogen in certain proportions, and passing this mixture over finely divided nickel or some other metal of the same chemical group, maintained at a temperature lying between 200° and 300° C., a liquid was obtained which resembled Caucasian petroleum in all its physical properties.

By varying the physical conditions of the experiment, an oil resembling the Galician petroleum which contains aromatic hydro-carbons was obtained, and when the temperature was lowered to 180° C., a product resembling the American oil was won.

When acetylene gas alone was led over the finely divided metals, hydro-carbons of the unsaturated series were obtained with exothermic reactions; when hydrogen gas was mixed with these hydro-carbons in the gaseous state, and the mixture was again led over the nickel, a product resembling the Caucasian oil was obtained.

These experiments therefore support the theory first put forward by Moissan, that a portion of the petroleum found in the earth's crust has originated by the action of water upon natural carbides, under certain conditions as regards the presence of metals and a temperature not exceeding 300° C. At present it is improbable that any practical application will be made of MM. Sabatier and Sendereus's discoveries. For many years it will prove cheaper to tap the natural supplies of petroleum than to produce the oil by synthetic methods from manufactured carbides. But it is interesting to have gained a fresh insight into Nature's method of production, and possibly the indirect evidence that large deposits of metal in the native state may be found in the neighbourhood of the oil-bearing strata of the earth, may be turned to practical use when these districts have ceased to be active as oil-producing centres for the world.

POLYPHASE WORK IN 1903.

By A. C. Eborall.

(*Concluded from page* 214.)

Passing on now to a consideration of present practice in power station equipment, the increase in size of the generating plant and the standardisation of the revolving field polyphase alternator are perhaps the most striking features. Two years ago the largest alternator at work had an output of 1,500 kw. To-day there are plants at work of double this output, and several more are being put down. It is hardly likely that an output much greater than this (3,000 kw.) will be required from a single unit for several years to come. In any case, it is hardly likely that *slow-speed* generators will be built in larger sizes than 5,000 kw. At speeds of 70 revolutions, or thereabouts, such machines (especially for 50 cycles) become of such diameters (if designed for the best electrical results) that the necessary stiffness in the stationary armatures can only be attained with difficulty, and at great cost, while the actual construction of such machines taxes the resources of any machine shop, apart from the question of the transport. On the other hand, nothing short of an extensive railway system would warrant generating units of this size, especially when it is considered what a very little thing is sufficient to shut the whole plant down—a trifling accident to the engine-valve gear, for instance.

It is satisfactory to note that the direct generation of the high-pressure current in the stationary armatures of the alternators is the usual practice in this country, which must be gratifying to Mr. Ferranti ; the bad example set in this respect by the first large polyphase plant installed in this country—the American plant at Willesden, generating 7,500 kw. at 500 volts—has not been followed. With such large plants, the limit of the working armature pressure is about 20,000 volts at present, for above this the insulating properties of slot insulations cannot be absolutely depended upon, while it is a difficult matter to insulate the ends of the coils properly, and in any case the machine becomes very costly to build. For pressures above 20,000 volts, step-up oil-cooled transformers must be used in conjunction with the generators, such transformers giving excellent results with even much greater pressures. With smaller machines than those referred to above, the limiting value of the pressure directly generated in the armatures is determined by the diameter of the armatures, and by considerations of cost ; for a given output at a certain speed, there will be a certain value of pressure beyond which it will pay best to use step-up transformers. But for work in this country at any rate, few cases are likely to arise which will necessitate the employment of such pressures (compared with the size of the unit) that indirect generation will be necessary.

A class of generating plant that has come to the front within the last year or so, in connection with large work, is the turbine-driven alternator, and if this type of plant fulfils the expectations of those responsible for its introduction, certain modifications will be introduced in the design of the revolving field polyphase generator. At present it must be admitted that the question of the choice of prime mover is a somewhat difficult problem to solve satisfactorily—the rival claims of the high-speed, medium-speed and slow-speed engine, the turbine, and even the gas engine, have to be considered, and where the circumstances of the case do not clearly indicate the type to be selected, the designer of a large scheme has plenty to think about in this connection. But it is quite certain, on the one hand, that high engine speed is exceedingly favourable for alternating-current work, especially in conjunction with pure rotary motion ; on the other hand, although gas-driven generators can quite well be operated in parallel at low frequencies (25 cycles and thereabouts), and can be successfully built in sizes up to 1,000 kw , yet they are at the present better suited for use in private power stations (steel works, &c.) than for really large work. Again, no experience is available as yet with regard to the operation of synchronous sub-station machinery from gas-driven alternators. The experience of the next two or three years will show whether the very large steam turbine is a practical possibility—that is, if its steam consumption, governing, and, above all, general reliability, are

equal to the corresponding performance of the best slow-speed steam engines. Should this turn out to be the case, it can only be a question of time before the use of the steam turbine will become general—at any rate, for alternator driving—for it must be remembered that no striking improvement can be expected in connection with steam engine work.

But this assumes that the gas engine and its producer plant stays more or less where it is at present, which by no means follows. Imagine, for instance, what an enormous impetus would be given to this branch of engineering if a practical gas turbine were discovered. In any case, the large gas engine and its producing plant have been enormously improved of late, so that this side of the question must certainly be considered, and all that one can say now is, that for future large schemes it looks as if it would be a difficult matter for the slow-speed steam engine to hold its own.

On the other hand, for smaller work it hardly appears likely that the English high-speed engine will be supplanted except in special cases, for the really excellent all-round results attained with these engines, when used within their legitimate sphere of work, are not likely to be improved upon.

A type of polyphase generator that will undoubtedly come to the front before long is the *asynchronous machine*, and the recent invention of Heyland for improving the power factor of induction motors will have led to this. To Heyland must be given the full credit of discovering the means of practically getting rid of the wattless currents of such motors, by producing the rotary flux by means of low-frequency rotor currents drawn from the line through a simple rotor commutator. This again has led up to the self-exciting induction generator, now a commercial possibility, and actually on the market. Such asynchronous induction generators require no exciter, and operate as perfectly in parallel as shunt-wound direct current dynamos, to which, indeed, their manner of working is quite analogous. In addition, they have the enormous advantage of having a pressure drop of the order of 3 per cent., irrespective of the power factor of the load; in fact, they can be even over-compounded. This is a very great step in advance, as will be readily seen when it is remembered that a standard revolving field polyphase generator has a drop of 16—18 per cent., even when the power factor of the load is no lower than 0·8.

A feature of the power station equipment that has, in the writer's opinion, been considerably neglected in this country up to the present is that of adequate and properly-designed high pressure switchgear, and yet this is a matter of the very greatest importance. In connection with several of the largest polyphase plants at present working, switchboards are in use, controlling machinery operating at 7,000 volts and more, which are sadly behind the times from the points of view of safety and convenience in working. Doubtless for lower pressures (up to 3,000 volts) such boards give excellent results, especially in connection with single-phase systems, but their application, almost without modification, to three-phase working at, for instance, 10,000 volts, must certainly give rise to difficulties sooner or later. One very undesirable feature, among others, is the fuse in the machine and feeder circuits, for if there is one thing more than another that has been demonstrated to be a mistake in connection with such work it is this; quite apart from the question as to the advisability, or otherwise, of fusing machine circuits, a fuse cannot be made in such a way as to open a 10,000-volt circuit (with a large amount of power behind it) *under all conditions* with certainty and safety. The only rational way of protecting a circuit of this kind is to employ a circuit-breaking oil switch; that is, the main oil switch is provided with a release attachment worked by a relay, enabling the *switch itself* to be opened at any predetermined value of current; the relay is worked by a small series transformer placed in the main circuit, and may, or may not, be fitted with a time adjustment and a "reverse current" attachment.

Mr. C. E. L. Brown led the way in the design of switchboards for controlling very large plants operating at pressures of 10,000—20,000 volts, and the American firms, in connection with their largest work of recent years, have not been slow to recognise this fact. The best work on the Continent and in the States is now being planned on the above lines, and it is only a question of time before this country will follow suit.

A feature of large new boards will be the abolition of ammeters working at high pressure, and a more extended use of power-factor indicators, together with improved synchronising gear and wattmeters.

With regard to the present position of polyphase transformers and induction motors, there is not a great deal calling for remark. The increasing use of the core type of transformer, especially for power work, is noteworthy as being a case of the survival of the fittest; modern three-phase transformers are, of course, always of this type. In the latter connection, it is worthy of note that in America one of the two large concerns has recently started a line of three-phase transformers, following the practice general on the Continent during the last eight years. The three-phase transformer is superior to three single-phase transformers, each having one-third of its output, mainly on account of the great help it gives in balancing the system, and its want was probably not felt in the States, because it is not until very recently that pure three-phase systems for supplying light and power have been put down there. It is to be hoped that British manufacturers now making a start in polyphase work will standardise from the beginning a complete series of such transformers, in addition to the single-phase transformers they have hitherto built.

With regard to induction motors, undoubtedly Heyland's compensating arrangement referred to above will come into use for the case of very large motors—more particularly for slow-speed motors, where the number of poles is relatively large, and in which, consequently, the power factor would be low under ordinary circumstances. Small and medium sizes of modern standard induction motors have already very good power factors over wide ranges of load, and for these it would not be worth while going to the extra expense of the commutator.

Many improvements in detail have been made in induction motors, mainly in the direction of reducing their weight for a given output without sacrifice of desirable electrical qualities, but matters are just about where they were with regard to the matter of economical speed regulation; for all practical purposes, rheostatic (rotor) control is all that is available. This is effective enough, but extremely wasteful if much regulation is required, and hence it is principally in this direction that improvements in induction motors must be looked for in the future.

The three-core cable, paper-insulated, is nowadays practically the only class of cable employed for three-phase work. With regard to the use of such cables for high-pressure working, it is now understood that the use of an auxiliary copper sheath beneath the armouring is *not* a compulsory requirement of the Board of Trade. This copper sheath, in addition to being expensive, is inconvenient, and not always effective, insomuch as the failure of one of the cores does not necessarily mean that the whole cable is cut out. Here again the writer thinks that the right way of protecting such a cable is by means of a maximum current oil circuit breaker at the home end, and a reverse current circuit breaker at the far end, which could be arranged without difficulty to cut out the *whole* cable, should a fault develop in any one core.

It may be noted in conclusion that a revision of the existing Board of Trade regulations governing the employment of alternating-current work, may be expected before long, and it is to be hoped that the new regulations will contain some definite indication of the real views of the Board on the subject of the high-pressure transmission and distribution of large amounts of polyphase power, overhead as well as underground. The next best thing to no regulations at all, is a set of perfectly definite general regulations, by which those responsible for laying out schemes and plants may be guided. At present, considerable doubt and misconception prevails on the subject, and it is to be hoped that this state of affairs will be remedied during the year 1903.

Theatre Installation.—Messrs. Roger Dawson, Ltd., have secured the contract for the whole of the electric lighting at the New Gaiety Theatre, including stage switchboards, dimmers, liquid resistances, &c.

FIXED SIGNALS ON LINE SIDE v. SIGNALS CARRIED ON LOCOMOTIVES.

[FROM A CORRESPONDENT.]

Leaving out of account the means of operation, and assuming equal reliability, the latter have the advantage of being equally visible during all conditions of weather, and, in most cases, the signal may be arranged so that any indication received at one signalling point will be continuously exhibited until the next point is reached. Such an arrangement would be of the greatest possible value in cases where a driver over-runs a signal, as, say, in the Slough accident.

The present method of signalling does not give this advantage.

Before any system of signalling directly on the engine, as the *sole* means of signalling, could be adopted, the following points would require careful attention :—

1. Failure of fixed signals, whether manually operated or automatic, results in local inconvenience only. With manually operated signals, the fixed signals would be superseded by hand signals, &c. With automatically operated signals, the time stop would be the only delay. In both cases ordinary signalling would be resumed at the next block.

On the other hand, failure of apparatus on the engine would result in inconvenience during the whole journey, or until the defect was remedied. The maintenance of such apparatus on locomotives would be difficult to arrange for unless the drivers and firemen were specially trained. Breakdowns on journey might or might not be repairable by the engine staff, according to the degree of simplicity of the apparatus. In this connection it must be remembered that the reliability which ensures adherence to the time-table is only a little less important than safety in railway working.

2. A point of great importance in signalling by the ordinary system is that when signals are exhibited at "danger," a driver approaching them is able to obtain *immediate* information of their being lowered for him to pass. After passing a "distant" signal at "danger," a driver usually has from 800 to 1,200 yards to travel before reaching the "home" or stop signal, and the latter is in plain sight for the greater part of the distance. Hence the driver is able to see *when* the signal is lowered, and if this occurs during his approach he can, of course, immediately go ahead without further loss of time.

With a system of signals given directly on the engine, the indication is only given at one point, and the driver cannot tell *until he reaches that point* what signal he will get. Moreover, he must be prepared to stop *at* that point, and must, therefore, approach it at a very slow speed. With such systems the driver must also stop within a very restricted space, as the indications will only be given to him when his train has been brought to a stand, when the engine circuits are in the proper position, relative to the line circuits, for operation.

This uncertainty respecting the indication to be received at the signalling point, and the necessity for immediately stopping in a very restricted space if a "danger" indication is received, would inevitably lead to great loss of time, often needlessly, if the "all right" indication has been prepared during the time a train is running up to the signalling point. The starting of heavy trains involves a considerable effort, and it takes a relatively long time to regain the normal speed. With fast trains the mere shutting off of steam on the level is looked upon as a loss of time, and the drivers of such trains will crawl towards a stop signal at "danger" at the lowest possible speed as long as possible, in order to avoid coming to a dead stand.

Referring to the "Miller" system more particularly, as explained in the *Electrical World*, it may be said that it is an adaptation of the "overlap" system of signalling used in the States. That is to say, that the signals given on the engine are of the same character as those given by the "overlap" system of fixed signals.

The following points are worthy of careful attention :—

1A. There is no difference of indication given on the engine to correspond with the "cautionary" and "stop" characters of the signals received.

Thus, suppose a driver running with a white light gets a red light on passing a signalling point. He does not immediately stop, as the signal (coming after a white light) is cautionary only and informs him that there is a train in the *second* section ahead. He therefore runs to the next signalling point with the red lamp all the way. On arrival at that point if there is another train in either the *next* or the *second* section ahead the indication on the engine remains exactly the same as it has during the journey through all the previous section. His signal does not tell him whether he should stop at that point or go on as before. Of course if the previous train is in the *next* section he should stop; if it is in the *second* section ahead he may go forward under the same conditions as those governing his action in the first section for which he got the red light. His signals, however, do not help him, and he may overrun the point at which he should stop. As there is no *change* in the character of the indication, the driver has no intimation when he has arrived at the next signalling point to that at which he got the red light. Under these conditions there is nothing provided of the "position" character of the ordinary fixed stop signal, which, of course, *marks* the position, which must not be passed when the signal is at "danger." Hence the danger of overrun is accentuated.

2A. The "Miller" system as shown could only be used on a straight road. *It would not select a route at a junction.*

It depends upon the adoption of the "track circuit," which is not yet established in this country, and which, owing to the numerous junctions, could only be used to a comparatively small extent. There would therefore require to be some other system of signalling in use, under manual control, to supplement it at junctions.

3A. The small battery H is intended to give warning of a break in the main circuit on the engine (a most necessary precaution). It does this by causing the red lamp to burn. This, of course, is the ordinary danger signal. Hence there is only *one* indication for a "stop" danger signal, a "cautionary" signal, and for a failure of apparatus, and there are no means shown for identifying one of these causes of the red light being given from the others unless it occurs between signalling points.

The reason for providing an indication to give notice of a break between the relay M and P, or between the battery H and N, as shown in the *Electrical World's* diagram, is that the existing light at the moment the break occurred, would not be changed at any subsequent signalling point. If a white light existed at the time, considerable danger would be incurred. If a red light existed at the time of the break, no indication of the occurrence would be given.

The differential balance of the relay M, to the battery H, would also be upset by failure of the battery S, at the moment that P and N were bridging the insulated rails at C, and the same thing would occur from total or partial disconnection of the battery leads to the rails. If the track circuit relay T, and the signalling relay R, were in the position shown at B, a white light *should* be given. The red light would, however, be shown by the action of the battery H, and it would not be in consequence of—

a, a train in the sections ahead ;

b, a break in the engine circuits (permanent) ;

and the train would be unnecessarily delayed.

If the train was running with a red light at the time that indication would be continued and the train unnecessarily delayed.

4A. Whilst provision has been made to give an indication of failure of apparatus due to a break in the engine circuit (but which cannot be identified from the "stop" danger, and the cautionary signals, or between failures of the actual circuit on the engines, or the signalling circuit on the track under certain conditions), no provision has been made in case of a "short" on the engine circuits.

If we assume a "short" anywhere on the wires, P and N, between the rails, and the relay M, the existing indication on the engine will be unchanged when passing a signalling point, as the line battery, S, will be closed through the "short," and will not operate the relay, whilst the differential balance of the latter with reference to H, will not be disturbed. If the existing light is white at the time when a "short" occurs, grave results may ensue, as that indication

will justify the driver in proceeding at full speed whatever the indication that *should* have been given at any subsequent signalling point. Such a "short," it may be observed, would result from a failure of the insulation of "one of the tender trucks which is insulated from the rest of the train."

5A. It has been pointed out in 1A that a train running with a red light obtains no change of indication at the next signalling point if there is another train in *either* of the next two sections, and cannot, therefore, judge whether to stop or go forward. If, however, it is assumed that a train is standing at such a place, it may be pointed out that it must stand exactly so that the points P N on the engine must bridge over the insulation between the rails at C, say, and that it will not even then receive any change of indication until the *two* sections ahead are cleared. Hence there is some delay.

ELECTRICITY IN MINING.

An interesting and instructive paper on the "Application of Electricity to Mining" was read by Mr. Daniel Burns, M.I.M.E., before the Glasgow Technical College Scientific Society on Saturday, January 24th. The paper deals briefly with the past and present progress of the application of electricity to the mining industry, and embraces the following:—

1. Lighting, both surface and underground.
2. Transmission of power for special purposes, such as coal cutting, drilling, pumping, hauling, &c., where, in most cases, the plant is placed underground.
3. Production of magnetism for the purpose of separating minerals.
4. Shot firing.
5. Transmission of signals.

A sixth application is mentioned at the commencement of the paper, but not dealt with, doubtless for want of time. This is the transmission of power for general purposes, such as driving coal-cleaning machinery, ore-dressing machinery, ventilating fans, and other surface plant.

We thoroughly endorse the views held out by the author in the commencement, to the effect that all mining and electrical engineers should acquire as much knowledge as possible of each other's professions, in order to be able to make proper use of, and successfully apply electricity to mining. The paper, as a whole, does not call for any very special comment, and indicates a masterly knowledge of the subject. There are, however, a few minor points which call for remark. We agree with the author that the dangers attending the use of electricity, even in fiery mines, have been greatly exaggerated, and also that by employing proper means they can be nearly eliminated, as, for example, in the case of an electro-motor, by enclosing it. It should be remembered that many motors are not entirely enclosed or gas-tight, but are ventilated, to some extent, by openings over the commutator, which are closed by wire gauge. This constitutes a possible source of danger, which can be minimised by allowing a sufficient area of gauze to enable the burning gases resulting from an internal explosion to be cooled below ignition point in passing through the gauze. This would not be the case with too small an area of gauze, and though probably this is a smaller risk than that incurred by the breaking of a cable, it must not, on this account, be lost sight of.

In dealing with power drills worked by electricity, the author rather leads one to believe that there is at present no successful electric percussion drill existent. We do, however, know of one at least which has given very good results abroad, and is now being introduced into this country. But for this kind of machine there is a large field, and therefore ample scope for the enterprising engineer in devising some new and improved form.

The arrangement suggested by Mr. Burns for signalling by means of an electric bell from the moving cage, at any point of the shaft, to the engine house, is an excellent idea, and cannot fail to commend itself to mining engineers as a device likely to be productive of much good.

The application of electric power for winding is the last point dealt with by the author, who considers it very briefly, and merely points out the difficulties met with. It is not easy to see why the speed of electric winding should be much lower than that with steam winding, if at all. Clearly the reverse might be expected, for in the electro-motor we have pure rotation, as against reciprocating motion in the steam engine. Undoubtedly series motors have exceptional properties for rapid acceleration, and with an electric brake, rapid stopping should be an easier matter still. With properly constructed motors, driven from a suitable generating plant, helped by a storage battery of high discharge-rate cells, it would seem that a greater acceleration than with steam engines should be obtainable at the winding drum.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c. may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"R. R." writes:—"I should esteem it a favour if you could inform me if supply authorities are compelled to supply a copy of their provisional order to anyone making application for same, and if so, at what price, as I have been refused one by a corporation engineer, although having received several others from other engineers of both corporations and private companies on payment of 1s.?"

*** The question put by "R. R." is answered by a reference to the rules made by the Board of Trade with respect to Applications for Licenses and Provisional Orders, which were published in 1890. By Rule 13, applicants for a license or provisional order must publish notice of their application by advertisement, and such advertisement must contain (*inter alia*) "the address of an office in London, and another office within the proposed area of supply, at which printed copies of the draft license or order when applied for, *and of the license or order when made*, can be obtained at a price of not more than 1s. each." By Sec. 5 of the Act of 1882, any rules made in pursuance of the section are to have the same force as if enacted by the Act, and are to be judicially noticed. In view of the above provisions, and having regard to the fact that the corporation is not under penalty to observe this regulation, it would be competent for the inquirer to sue for a *mandamus* to compel the corporation to sell him a copy of its provisional order for the sum of 1s.

LEGAL.

Manchester Tramways Arbitration Case.

In the Court of Appeal on Monday Lords Justices Vaughan-Williams and Mathew had before them an application in the matter of an arbitration between the Manchester Carriage and Tramways Co. and the Lord Mayor, Aldermen and citizens of Manchester and other local authorities. The application was by the Lord Mayor of Manchester and others to advance the hearing of the appeal in this case.

Mr. Lawson Walton, K.C., who appeared in support of the motion, said the appeal was from a judgment of Mr. Justice Bigham on a special case stated by an arbitrator to determine the sum which the Corporation of Manchester and 11 other different bodies had to pay on taking over the tramways in the City of Manchester and district. The alternative award specified two figures—one a sum of about half a million of money and the alternative sum a quarter of a million of money. When the matter came before Mr. Justice Bigham he confirmed the award, embodying in it the larger figure. The appeal from that decision affected a quarter of a million of money. The chief difficulty the Corporation was in was that there were no fewer than 11 local bodies interested in the question, and there was a great deal of property in the nature of depôts formerly used by the Tramways Co., and representing a total value of £144,000. These depôts were lying quite useless, and there were heavy outgoings in the shape of rents and taxes. The Corporation did not know whether they were to take these depôts over or not till the appeal was determined. A sum of £24,000 a year in the shape of interest was being paid over.

Mr. Fletcher Moulton, K.C., said he appeared for the Manchester Carriage and Tramways Co., and he was quite willing that the hearing of the appeal should be advanced. He held the judgment of the Court below.

Mr. Walton said the case stood only seventieth out of the list, and he asked their Lordships to take it towards the end of this month.

Lord Justice Vaughan-Williams: Reluctantly I consent. I say so, because I cannot help feeling that public bodies should be more

reasonable in asking to have matters expedited in this way. It is very hard on other litigants.

Mr LAWSON WALTON said a great many difficulties had been smoothed over, but the main question had to be determined as to what properties the Corporation was to take over.

It was afterwards arranged that counsel engaged in the case should decide upon a day for the hearing of the appeal, and apply to the Court to have that date fixed.

THE MARCONI WIRELESS TELEGRAPH CO., LTD.

IN the Chancery Division on Saturday before Mr. Justice Farwell, Mr. Upjohn, K.C., appeared in support of a petition by the company asking the sanction of the Court to special resolutions which had been passed under the Memorandum of Association Act, 1890. Learned counsel said that the company was formed in July, 1897, to take over and work a number of patents granted to Mr. Marconi in connection with his system of wireless telegraphy. At the time the patents were acquired the invention was not perhaps very widely appreciated, but now after a great expenditure of money and many experiments, there had been actual practical results, and King Edward and the President of the United States had exchanged messages by the Marconi system. The birth of a child had also been passed over the system, so that he might say that wireless telegraphy was now indisputably associated with our domestic life. In fact, the invention had now attained such dimensions that he might paraphrase Dr. Johnson by saying that it possessed potentialities beyond the dreams of science. The desire of the company was, of course, to develop the Marconi patents to their full extent, though it was difficult for the moment to say what was the full extent. It was believed that the invention was available not merely for telegraphic communication, but for lighting, and, above all, for traction, the enormous advantage of which would be at once seen when he stated that it would do away with all the unsightly overhead wires. With regard to telegraphy, it was now ascertained that it was possible to send messages all over the world, even from England to Australia. The current followed the curvature of the earth, and practical arrangements only were wanting to achieve Ariel's circle round the earth. But the operations of the company were not confined merely to plane surfaces like the sea, as it was possible to telegraph overland, and here it was important that the powers possessed by the company should be made plain. It was possible to telegraph from Cornwall to St. Petersburg, but there were difficulties in the way. He supposed the Postmaster-General would object to their doing it in England, and possibly France would object also as regarded that country. In all countries now telegraphy was a monopoly, so that whenever messages were sent overland it would be necessary to make arrangements for their despatch and distribution. But there was auxiliary business which the company would be enabled to do. The Marconi Co. was now the competitor of the great cable companies, and he thought they were very much cheaper. The cabling of money was an appreciable part of the business of the cable companies, and the company were anxious to embark in that business, if they had not already the power. Then there was the novel idea of publishing newspapers on board ship. By the Marconi system it was possible for ships to receive news in transit, and a daily 6d. newspaper on the great liners might possibly prove a substantial source of profit. The alterations now proposed in the memorandum of association, were such as in their opinion would enable the company to carry out these and other objects in the best way.

Mr. Justice FARWELL thought the case was quite unique. Though the proposed alterations were sweeping ones, it was perfectly true, as had been said, that the possibilities and potentialities of the company were so great that they were amply justified in asking for powers which they needed. He saw no difficulty whatever in sanctioning the petition, and he made the order accordingly.

COUNTY OF LONDON AND BRUSH CO. *v.* FARRANTS.

LAST week, at the Wandsworth County Court, before the Hon. Arthur Russell, the case of the County of London and Brush Provincial Electric Lighting Co., Ltd., of Moorgate Street, E.C., *v.* Farrants was disposed of. The plaintiff company sued Mr. Arthur Farrants, the defendant, who is the proprietor of the Bull and Star Hotel and the Spotted Horse, Putney, to recover the sum of £25 10s. 8d., the balance of an account for electric energy supplied to the first-mentioned house, and the defendant counterclaimed for rebate and damages for the cutting off of the electric supply at the Spotted Horse. Mr. Arnold Inman was counsel for the plaintiffs, and Mr. R. O. B. Lane represented the defendant.

In the course of his opening statement, Mr. INMAN produced a meter and an index similar to those used at the Bull and Star, and said that the defendant had been supplied with electricity for the past four years. Having explained the terms of the contract, the learned counsel said that the defendant had paid his accounts up to September, 1901, but in the following December trouble commenced. Mr. Farrants, on receiving his account for the December quarter, applied to have his indicator tested, and it was found to be perfectly correct. In March application was again made for payment, the company notifying the defendant that unless a cheque were received on the following day the supply would be disconnected from the service box outside his premises. Nothing was paid, however, but the company did not press the defendant because they held a deposit of £50. On June 19th Mr. Farrants sent a cheque for £30 on account, promising another payment directly after the Coronation. The March account was then due, and the June quarter was becoming due, the total being £67 0s. 3d., of which the defendant paid £30. The company wrote asking for the balance of £37 0s 3d., pointing out that his premises would be liable to disconnection. Coming to September, the defendant owed £25 10s. 8d., the amount now sued for.

Mr. LANE, on behalf of the defendant, said that his client had made all his payments under protest, and he counterclaimed for the disconnection of the light at the Spotted Horse. The contract provided that in the event of an account remaining unpaid for 15 days, the company had the right to discontinue the supply; but in the case of the Spotted Horse, the account had not even been rendered.

Mr. F. C. M'EWAN, assistant secretary to the plaintiff company, formally proved that £25 10s. 8d. was due for electricity supplied to the Bull and Star.

By Mr. LANE: It was a very large house, where a large catering and general trade was done.

To the JUDGE: The company had 4,000 other customers, including 200 public houses, all of whom were subject to the same contract.

His HONOUR said that a more complicated contract he could not possibly conceive, and he never could understand why electric lighting companies charged for the use of meters which were for their own benefit, checking the amount consumed. He called it a shocking imposition.

HENRY JOSEPHS, one of the company's collectors, said that after he had cut off the supply at the Bull and Star, the defendant told him that he had better go and disconnect the light at the Spotted Horse, and he eventually did so. This was the case for the company.

Mr. ARTHUR FARRANTS, the defendant, said he had just returned from town when the light was disconnected at the Bull and Star. He was naturally irritable, but it was utterly untrue to say that he told the men to disconnect the light at the Spotted Horse. At that house, for the express purpose of the electric light, he had purchased for nearly £400 a clock containing a statue of Liberty and a view of New York Harbour, which proved a great attraction to his saloon bar. The installation cost him £25 or £30, and he had since spent £20 in gas, besides being prevented from getting the rebate on his electric lighting account. His takings fell off, and he now claimed damages for the loss he had incurred on 98 days.

Miss FRENCH, a young lady employed at the Bull and Star, corroborated the defendant's evidence, and said that no order was given with regard to the Spotted Horse.

His HONOUR said there was absolutely no defence to the action, and his time had been wasted in hearing it. It was a very complicated contract, and extremely difficult to understand, but the defendant was a full grown man, and having entered into it, he must abide by the consequences of it. At all events, he had had four years in which to master it. Was it at all likely that the servants of the company would have cut off the light at the Spotted Horse without being told? He thought there could be no doubt that the defendant, in a fit of pique and anger, told the men to do it, and he, therefore, gave judgment for the plaintiff company on the claim and counterclaim, with costs.

CORRESPONDENCE.

Entropy.

In Prof. Perry's letter last week he says: "My first letter of a month ago was in answer to what I felt to be a not very brave attack on myself, which I could only resent as being hurtful to students." The note in my address criticised "most treatises on the steam and gas engine," and the $\theta\phi$ diagram; also "nine out of ten treatises on mathematical physics." I also said "most writers define entropy incorrectly." I also criticised the use of $d\phi$ as a typical exact differential in the passage Prof Perry has quoted. Now, how can all this very broad criticism of writers on steam and gas engines, writers on physics, and writers on mathematics be a not very brave attack on Prof. Perry? As to "not very brave," I will leave it to your readers whether I am addicted to anything cowardly in the way of attacks on particular people. I think I am generally ready to speak openly, and with the courage of my opinions. But I had no sort of motive for attacking Prof. Perry bravely or not very bravely. The only man I had had any difference with on a point of thermo-dynamics, and that a scientific, not a personal, difference, is not Prof. Perry at all; and we are on the best of terms. I may say definitely there was absolutely nothing whatever in the whole address directed against Prof. Perry himself; there is no reference to him whatever in the printed version, and in the verbal edition the only reference was when I regretted I could not hope to give as brilliant an address as his. Even if I had attacked Prof. Perry in particular, it is very regrettable that he should adopt the tone of infinite superiority he chooses to

assume; I have not done so towards him, and have discussed anything in the way of thermo-dynamics that he has brought forward on the understanding that he is a man of ability, and anything he says, especially on a scientific subject, is worthy of attention. Enough as to personal matters.

As to thermo-dynamics, Prof. Perry does not really discuss, he merely contradicts my statements on his own authority.

In your issue of January 23rd Prof. Perry wrote, "That Clausius used a term in one sense, and that all modern men use the same term in another sense, is a matter perfectly well known. . . ." This was in a letter headed "Entropy," and Prof. Perry's contention is that $\int d\text{H}/\theta = \phi$ is a definition of entropy, while mine is that it is not, because, as Clausius shows, and says, $\int d\text{H}/\theta < \phi$ in all wholly or partially irreversible changes. I think the fair reading of the passage quoted is that the "term" is the term entropy. He now says: "I might have known that Mr. Swinburne would take this 'term' in a wrong sense." Then will Prof. Perry say clearly what he did mean about Clausius's term? I have not Hirst's translation of Clausius's papers; but I have Browne's translation of "The Mechanical Theory of Heat," which, according to the preface, was so completely re-written by Clausius that Hirst's translation has been found scarcely anywhere available. It may therefore be taken as an exposition of Clausius's views, and in it Clausius says, on non-reversible processes: "Thus to express the general principle, we must write in place of $(f)d\text{H}/\theta = 0$, $(f)d\text{H}/\theta \leqq 0$, and equation $d\text{H} = \theta d\phi$ then becomes $d\text{H} \leqq \theta d\phi$."

As to what I mean by θ when I discuss such equations as $\int d\text{H}/\theta < \phi$, or $d\text{H}/\theta < d\phi$, θ is the temperature at the surface, across which the heat considered is transferred. If the change is reversible, the reservoir, the separating surface, and the substance are all at the same temperature. The reservoir is always supposed to be so large that its temperature is uniform. If the process is irreversible, and if the temperature of the substance is not uniform, then θ is the temperature of the surface of the substance, which is the same as that of the reservoir. It could not be the temperature of the whole substance, because that is not uniform. If the temperature of the reservoir were not uniform, then θ would still be the temperature of the surface of the substance, and the "temperature of the reservoir" has no meaning. If you take two bodies, one hot and the other cold, each at uniform temperature, and put them together, the temperature of each is at once no longer uniform, and $d\text{H}/\theta < \phi$ for both of them, θ being the temperature of the bounding surface, not the temperature of either one of them as a whole, that is meaningless, and either of the bodies may be considered as the working substance. If the working substance is not uniform in temperature, there is conduction; an irreversible process involving increase of entropy. If the body is split up into elements, each element is not uniform in temperature, and the temperature of the element is as vague as the temperature of the body. In thermo-dynamics, therefore, in $\int d\text{H}/\theta$ when referred even to an element of volume, θ means the temperature of the surface of the element, and $\int d\text{H}/\theta < \phi$ for each element, as well as for the whole body.

When I say that "entropy is not a factor of heat corresponding to temperature," I mean that $\int \theta d\phi$ is not necessarily the heat of the substance. Other forms of energy, such as $\int p dv$, $\int x dx$, $\int v/d\text{Q}$ (electric), &c., are made up of tension and quantity factors. I say that ϕ is not a quantity factor of heat, such that $\int \theta d\phi$ is energy, or increase of energy of the body. In the single case of a body taking in or giving out heat reversibly without otherwise losing or gaining energy $d\text{U} = \theta d\phi$, but in all other cases $d\text{U}$ is not equal to $\theta d\phi$.

As to ϕ essentially concerning the reservoirs, I mean that it is eventually or originally measured by the increase or decrease of entropy of the reservoirs after a reversible change. Though the entropy in state B may be got from the other co-ordinates, that is only after the determination has been first made by the change of entropy of the reservoirs when the body is brought from A to B or B to A reversibly.

I would point out that the whole of the discussion about a body whose parts are at different temperatures has been introduced by Prof. Perry since the address. It is one case of irreversibility only. I have already given elsewhere various cases of irreversible change where there is no want of uniformity of temperature. Prof. Perry says: "When any philosopher speaks of a body undergoing an irreversible operation, he means that, during the operation, its temperature is different in its different parts." I disagree entirely. I say there are any number of cases of irreversibility other than conduction of heat. I regard the idea that the only irreversible process is conduction of heat, or that the total entropy only increases where there is equalisation of temperature going on, as wholly erroneous. I have given my reasons very fully already.

James Swinburne.

41, Palace Court, W.

Pupin's Telephone System.

I have to thank the translator for his explanation of Dr. Pupin's formulæ, although I can but wonder that they were not shown more fully in the first instance.

Dr. Pupin's formulæ now show the effective current received as

$$\text{I}_e = \frac{\text{A}}{\sqrt{2}} \sqrt{\frac{2}{\varepsilon^{2\beta l} + \varepsilon^{-2\beta l} - 2\cos al}} \qquad (1)$$

and the effective current sent as

$$\text{I}_g = \frac{\text{A}}{\sqrt{2}} \sqrt{\frac{\varepsilon^{2\beta l} + \varepsilon^{-2\beta l} + 2\cos 2al}{\varepsilon^{2\beta l} + \varepsilon^{-2\beta l} - 2\cos 2al}} \qquad (2)$$

Others have, however, given formulæ for the same problems that differ from Dr. Pupin's; and even if one is correct all cannot be.

Nevertheless, these formulæ are interesting, and even useful, if they are not taken too seriously, but regarded more as illustrating a principle than as stating facts.

Take, for instance, Dr. Pupin's value of

$$\beta = \sqrt{\frac{p\,\text{C}}{2}\left(\sqrt{p^2\,\text{L}^2 + \text{R}^2} - p\,\text{L}\right)}. \qquad (3)$$

It will be seen that the larger L is made, the smaller β becomes, and the greater I_e, and that I_e can be increased indefinitely by increasing L.

But it is well known that there is a certain definite relation between p, L, and C, that makes the value of the received current a maximum, and that either an increase or decrease of L from that value leads to a decrease in the received current.

As regards formula (2), it will be seen that the right-hand term never differs much from unity, and that formula shows that a large alternator might be short-circuited with impunity, provided that there are not some other factors hidden away under the complex function A.

I do not wish it to be thought that I am condemning the Pupin system, and I think it is quite feasible to telephone from London to Berlin across the German Ocean—that is only a question of expense and Pupin's coils.

W. Moon.

The I.E.E. Students and the Building Fund.

In reply to "M.I.E.E." *re* the Students of the Institution of Electrical Engineers being asked to subscribe to the building fund, he is mistaken as to the origin of this movement; this appeal has not been made by the Council of the I.E.E., but by the committee of the Students' Section, and the circular was issued by the hon. sec. of that section.

It is astonishing that a man signing himself "M.I.E.E." should be so blind to the welfare of the Institution as to make such a statement, that he is "very much against our possessing our own building."

I do not think it is a mistake to appeal to the Students to help this fund; in the event of the Institution becoming possessed of a building, whether of their own or conjointly with other Institutions, the Students would reap as much benefit from it as anyone, and the amount which it was suggested every Student should subscribe was 2s. 6d., so that this, the Student himself could with little difficulty, I think,

manage to save even if he is earning no money. I am glad to be able to inform "M.I.E.E." that if he would look through some of the replies that have been received (which I shall be pleased to place at his disposal for that purpose) he would be surprised at the generosity with which this appeal has been responded to, and the enthusiasm shown is evidence that many of the Students recognise the desirability of a building for the Institution of Electrical Engineers.

Harold D. Symons,
Hon. Sec., Students' Section.

Speedy Tramcar Erection.

I am compelled to write a final reply to "Not one of the Gang," because he obviously evades the truth by correcting me for showing that the time he admits having been spent on 75 cars is nine weeks. In your issue of January 16th, page 96, he stated the period as "October 1st to the back end of November." That is nine weeks all but two days. He had his leading hand there at least four weeks more, and his foreman longer. But note his evasion, page 216, February 6th: "I said three weeks (not nine weeks)."

No doubt exists in my mind that he is of the gang, and if so, he has the costs of the Bristol work at hand. It is not unfavourable if honestly compared, I feel confident, but what has cost to do with speed?

I asked: "Can anyone show a record equal to Bristol, viz., 10½ cars per week for 13 consecutive weeks, including 25 cars per day on two consecutive days?"

He replied (page 96, January 16th): "Yes, 'better' at Manchester: 8⅓ cars per week for nine consecutive weeks, including 4½ per day for seven consecutive days." I have done the arithmetic on his figures because he is weak on that subject, and for comparisons I prefer the same time units, though he does not. Thirty per week sounds more than 4½ per day.

I make his overall efficiency (assuming he has kept up the rate of 8⅓ per week since November 30th; he had 200 cars to do) 8⅓ over 10½ equal to 79 per cent., and on the specially quick part his efficiency is 4½ over 25, which equals 18 per cent. 79 per cent. is "better" than 100 per cent.! Also 18 per cent. is "better" than 100 per cent.! I have finished.

J. William Smith.

[This correspondence is now closed.—Eds. Elec. Rev.]

The Wiring of Buildings.

It is a pleasure to see that the question of wiring is now concentrated on the practical point of having an inspector in each district.

The letters of Mr. Mautby Hill and "Fair Competition" are examples of the true spirit which ought to prevail. They are not afraid of having their work inspected, and if all were like them we should soon have the standard of wiring raised to a safe level.

Mr. Stegmann's views seem to represent those of the class on the other side of the dividing line who are well pleased with the existing state of affairs.

Let us welcome the inspectors by all means and the minor disputes wont do much harm. Consulting engineers supervising large jobs on a supply company's system usually rub along all right with the company's inspectors, and so will the insurance experts when they come.

I hope that Mr. Mautby Hill and "Fair Competition" will not allow the subject to drop; others are sure to speak up, and we shall no doubt eventually obtain some stricter supervision of wiring than presently exists.

Twin Wire.

February 7th, 1903.

In reply to "Foreman's" letter, I think it is a matter of almost universal experience to find the test fall after fixing blocks, switches and roses, and more especially during a spell of damp weather. I have never seen a job tested, but this has taken place. From my own observation and experience, I can only advise "Foreman" to do as I am doing; give every scrap of woodwork taking a fitting of any kind, both on walls and ceilings, three coats of the thickest shellac varnish procurable. This will not wholly rid him of the difficulty, but it will minimise the trouble. Of course it is almost useless to tender this advice in respect to cheap competitive work, but if he will try the experiment where the price will stand it, I am sure he will be satisfied with the result.

I can quite sympathise with "Foreman," but how is an engineer to tell at a glance from what cause the low test arose? He tests, finds a low reading, and concludes that the work is faulty. Natural enough, because *damp will search out faults*, and indifferent work may be found in poorly insulated wire (even though labelled 800 megs.), badly pared braid and tape at the fittings or insufficiently insulated joints. Tube work needs care of a more than ordinary kind to yield highly satisfactory results to all parties concerned, and I can only say to "Foreman," it is the trifles that tell. Use the shellac pot freely, and don't forget to test the wire before using it even though there be a label of 600, 800, or even 1,200 megs. thereon. Rubber burnt in the vulcanising is a nuisance, and a damp day or ordinary condensation will play havoc with the test if such is used.

Another Foreman.

I have read the letter of your correspondent on the subject of unreasonable charges made by central station engineers, especially those in charge of municipal undertakings, and think that a recent experience of the unreasonable attitude of those gentlemen with regard to the fee of 10s. 6d. for second and subsequent tests might be of interest to your readers.

A building for which we were the wiring contractors had to be finished in sections, so that as each section reached completion it could be occupied.

The first test was, of course, made free of charge, and we were then informed that before any more sections could be connected a fee of 10s. 6d. for each would be required; this will mean two at least, probably three, fees to be paid by us.

Do you not think, Sir, it is advantageous for the central station to have the benefit of the first section lighting while the next is being completed. A gas company would have made no charge even had a temporary meter been required, and any number of lights added subsequently.

In this case the service connections and meter are permanent, the tests throughout have been satisfactory, and all that the Corporation have to do is to send a man with a testing set which takes about half an hour of his time. Surely this is not the best means of advertising a municipal undertaking, and in these days of cutting prices is decidedly rough on the contractor who has to bear the loss.

John Biggs.

Borough Road, S.E.,
February 7th, 1903.

Charges for Electrical Energy.

With reference to his article last week, Mr. Bastian ought to be very grateful to the French writer for enlightening him on the two-rate method of charging for electricity which has so suddenly captivated his fancy. It would appear that Mr. Bastian is ignorant of all that has been written on the subject of charging for electricity during the past 10 years, and it is reserved for this casual article in a foreign journal to arouse him from his indifference and to induce him to contribute his waking thoughts to your paper. For Mr. Bastian these thoughts may possess all the charm of novelty, but to most of your readers his statement of them must be very ancient history. Further, why go to France, where the subject is only dealt with in its most attenuated theoretical aspect, instead of investigating what is actually happening in England and the United States, where something useful may be learnt? It is well-known that electric lighting methods, both as regards production and prices, are in France much behind those in this country. Much importance is attached to the statement that "the charge to the consumer *cannot only be based upon the cost of production*, while a

little later it is claimed that the two-rate system is the *summum bonum* of the author, and *has the advantage that the cost of production can be taken into account.* This is the only advantage worth citing, as Mr. Bastian's conjecture as to what the consumer will or will not do is valueless.

There is no analogy, as any engineer can recognise, between the carriage of different classes of postal packets at various rates for the public convenience, and the commercial business of generating and selling electrical energy. To accept such a proposition as an analogy, together with the confession that the maximum demand system is exceedingly complicated, betrays a state of mind that is ill fitted to cope with the problem of charges for energy.

Mr. Bastian may be surprised to learn that the "utterly impracticable system" of a time switch and demand indicator is not only already in use, but is being contemplated for adoption by several of the leading central station engineers. I should hardly think this fact would have much weight with him, judging from the irresponsible tenor of his article. The maximum demand indicator does not discriminate between the times of day or night, but that is hardly necessary. How many consumers does Mr. Bastian know of whose maximum demand for lighting is at midday, and who would be better off on a flat rate than on a maximum demand tariff? I would refer him to the conditions at Stepney, and the results gained there.

The quibble about occasional cutting out of the demand indicator will not deceive station engineers, for whose instruction Mr. Bastian is presumably writing. I can assure him that most of them have a better grasp of the subject than is displayed in his contribution.

After stating the momentous fact that conditions are changing with regard to electricity supply, and giving the dubious information that some gas companies have a peak between 12 and 1 p.m., he concludes that this accounts for some authorities having gone over to a flat rate from the maximum demand system. He omits to mention that this has usually been at the instigation of the short-hour element on the Local Council, and also that the consequences have sometimes been disastrous. Take the case of Burnley. During the first year after the change from maximum demand to a flat rate, 48 new consumers were added, but the revenue was £600 less, and that this was not solely due to a low flat rate was shown by the fact that 6,000 units less were generated for lighting. In short, business went backward, and the average charge to consumers was higher.

The gem of this remarkable article is this:—"The aim must be to make the turnover as large as possible at a fair average profit, and to reduce the cost of production in every available practical way." A fair average profit, and how to obtain it—that is just the question which leads direct to differential rates. How clearly put! One can almost hear these words ringing down the sand of times, as my Irish friend would say. But, personally, I don't care for empty platitudes. Why does not Mr. Bastian tell us how to do it, and why does he not frame the carefully thought-out sliding scale of discounts he alludes to?

I have frequent opportunities of discussing with central station engineers and town authorities this very subject of economics, and because I know that public knowledge is not at such a low ebb as to be receptive of Mr. Bastian's wild guesses, is my only excuse for inflicting this long letter upon you.

Out of the fulness of inexperience it is stated that the advantages of electric lighting will be sufficient to enable us to retain the long-hour man. But when, and at what price? These advantages alone do not do it now. That prepayment meters will make the household expenditure appear less will no doubt be gratefully accepted.

I should not advise anyone to take his last tip about specially low rates of discount to consumers open to 10 p.m., unless Mr. Bastian will indemnify them through a guarantee society against proceedings under the "undue preference" clause.

I may mention, in conclusion, that a good many flat rate stations have come over to the maximum demand system, and more are coming. I have no hesitation in saying that, did the matter lie with the engineers, the flat rate stations would be in a small minority.

What engineers require is light on the subject by practical and experienced men, not a string of disjointed opinions devoid of either logic or intelligence.

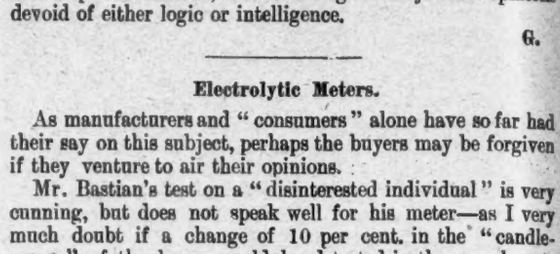
G.

Electrolytic Meters.

As manufacturers and "consumers" alone have so far had their say on this subject, perhaps the buyers may be forgiven if they venture to air their opinions.

Mr. Bastian's test on a "disinterested individual" is very cunning, but does not speak well for his meter—as I very much doubt if a change of 10 per cent. in the "candle-power" of the lamps could be detected in the way he sets forth in your last issue.

Mr. Bastian says: "We will connect the meter" (perhaps of 10-ampere capacity) "in circuit with a lamp on a 220-volt circuit." A lamp, mark you—he very wisely says nothing about the meter's efficiency on full load.



10-amp. Bastian meter; voltage drop ——, watts lost, - - - -

I have not a word to say against its accuracy, but cannot praise its efficiency. I am absolutely disinterested, but when I can get an electrolytic meter (and indicator combined if necessary) to work on full load with a voltage drop of 1·2 volts, I cannot help murmuring at the wastefulness of Mr. Bastian's meter in this respect. He gives us no *figures* on the subject in his letter, and in order that this point may be cleared up, I enclose a curve showing the voltage drop in, and the watts absorbed by, a 10-ampere meter from no load to full load. The voltage curve for a 2½-ampere meter is almost identical. The P.D. between the meter terminals is never less than 2 volts when on load, and on rated full load attains 5·3 volts, the energy absorbed at this latter point almost equalling that expended in a respectable 16-C.P. lamp. I need scarcely add that the meter was set up exactly as prescribed by the company.

Electron.

February 9th, 1903.

The Metric System.

The recent discussion at the meeting of the Institution of Electrical Engineers on the metric system seems to have put back the solution of this question for years.

Sir Frederick Bramwell as an opponent cannot be overlooked, but it did not seem to occur to any one present what a large amount of time the average boy loses during his school time in remembering that 14 lbs. make 1 stone of coal, and 8 lbs. 1 stone of meat; that 30¼ sq. yds. make 1 sq. pole, but 5½ yds. in linear measure.

Such puzzles disgust the youthful mind, and give the German boy, with his metric system, hours of leisure to learn English, French and science subjects. Apart from the relative values placed on education by German and English parents, also the vastly more regular attendance at school, the German lad has at least from five to eight hours per week saved by his metric system, to devote to other subjects.

With the coming developments under the new Education Act, surely the Education Department at Whitehall could make a beginning in all schools—both primary and secondary, commercial and technical—either by making the teaching

of the metric tables and actual handling of weights and measures one of the conditions for receiving Government grants, or else by insisting that all pupil teachers, students in training, and certificated teachers should pass an examination on the metric system.

Probably it would be useless to try and get the older universities of Oxford and Cambridge to interest themselves in the matter, but surely the up-to-date university colleges and technical schools might seriously consider it.

If the next two generations had a sound knowledge of both systems, the time of its adoption would not be far distant.

Curiously enough, the Civil Service Commissioners who examine candidates for London police inspectors always insert one or more questions on the metric system in the arithmetic paper, but why or wherefore no man knoweth.

Sir F. Bramwell's point as to showing the value of a third or a seventh by the metric system would be an interesting point for discussion by your younger readers who are budding mathematicians.

F. H. Wiltshire.

Wireless Telegraphy.

As a shareholder in the Marconi Co., and a telegraph engineer of some years' standing, I read with considerable interest the leading article in your issue of January 30th, headed "Wireless Telegraphy."

The writer argues, because contracts for submarine cables stipulate that certain tests shall be successfully carried out after the cable is laid, that before the Post Office grants the Marconi Co. certain facilities, the Marconi Co. should show to a jury of experts the working of their system. The company is not very communicative as to the methods by which it obtains certain results, but there seems to be no particular reason why they should not show electrical experts their system working, other than the desirability of not disclosing certain trade secrets. There appears, however, to be a defect in the reasoning of the writer of the article when he argues from the premises relating to the cables that such a demonstration should be a condition precedent to the granting of certain facilities by the Post Office. The demonstration of the manufacturer of the cable is a demonstration by a contractor to his employers. In the cases where the demonstrations are made, the cable company is employing a firm to manufacture and lay the cable, and naturally requires that certain tests shall be fulfilled before payment is made. Were the cable company to manufacture and lay its own cable, no demonstration other than one to its own employés for its private satisfaction is made, or is necessary.

If the Government were buying the Marconi system, it would be neglecting its duty if it did not insist upon certain tests being complied with before payment was made. The circumstances are, however, that the Marconi Co. has put down its stations at its own expense to work them for receipts, and it is no concern of anyone except the company's shareholders (and people from whom it takes money) how the stations work. The shareholders can call the directors to account if the company's stations are not properly worked and administered, and the public have the ordinary remedy of abstaining from use of the system if it does not work well.

The suggestion that the Post Office cannot allow its system to be used in conjunction with a service which has not been demonstrated to be perfectly trustworthy, is ridiculous. The Post Office takes no responsibility for cables which originate at its offices and pass over its lines to the cable companies' systems. The Post Office do not ask the cable companies to show by tests after a cable is laid that certain results can be obtained from it. This is the cable companies' concern solely, and if a test is exacted it is by the cable company from the contractor.

J. Leslie Fuller.

[Our correspondent writes in evident good faith; but he has missed our contention, viz., that the question in this case is not one as between contractor and manufacturer, but as between the public and the pioneers of what is claimed to be a revolution in trans-oceanic telegraphy.

The case cited in our issue of 30th ult., of the 1865 Atlantic cable had reference to a test designed at the time to prove the practicability of long-distance submarine telegraphy, which, like wireless telegraphy to-day, was then in its infancy, only far less so, and this test was intended to overcome the deep-rooted scepticism which then existed as to the possibility of establishing and maintaining reliable telegraphic communication across the North Atlantic. Public scepticism in this matter had been much strengthened by the failure of the 1858 Atlantic cable.

What still takes place as regards the guarantee of submarine cables is now, of course, purely a matter between contractor and purchaser, and has no longer any public interest.

According to our correspondent, promoters of revolutionary schemes are justified in claiming the co-operation of any Government, with all the commercial advantages of such co-operation, and at the same time they may withhold rigidly from the particular Government department concerned, the opportunity of satisfying itself of the practicability of the scheme. In other words, the Post Offices of the United Kingdom are to be made so many centres for accepting public money and public messages for transmission by any new system, without a satisfactory demonstration or guarantee of any sort from the representatives of the system!

The demonstration which we have suggested to prove the possibility of reliably and commercially working wireless telegraphy across the North Atlantic need in no way involve a disclosure of the "trade secrets," as to which the wireless company and our correspondent himself may possibly feel apprehensive.—Eds. Elec. Rev.]

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Feb. 11th, 1902.		Week ending Feb. 10th, 1903.	
Alexandria	Value £42	Adelaide. Teleg. mat.	Value £575
Amsterdam	50	Amsterdam	83
Beira	53	Auckland	10
Bombay	83	Bangkok	275
Buenos Ayres	309	Bombay	22
Teleg. cable	275	Bordeaux	125
Calcutta	655	Calcutta	3,507
Teleg. mat.	150	Cape Town	91
Teleg. wire	59	Channel Islands	45
Cape Town	433	Colombo	69
Channel Islands	294	Copenhagen. Teleg. wire	18
Chinde	28	Durban	300
Colombo. Teleg. mat.	245	East London. Teleg apparatus	100
Copenhagen. Teleg. wire	116	Fremantle	21
Durban	1,211	Ghent	30
East London	96	Gibraltar	33
Gibraltar	15	Hamburg	15
Teleg. mat.	35	Teleg. cable	50
Hamburg	40	Hong Kong	20
Hobart. Teleg. mat.	36	Karachi	12
Hong Kong	90	Lisbon	33
Lisbon	50	Madras	76
Melbourne	500	Melbourne	542
Otago	120	Ostend	200
Perth	140	Otago	484
Port Elizabeth	510	Perth	25
Rosario. Teleg. mat.	828	Port Arthur	187
Teleg. wire	7,800	Port Elizabeth	104
Shanghai	42	Port Said	40
Singapore	776	Shanghai	894
Suez. Teleg. mat.	144	Sydney	188
Sydney	134	Wellington	231
Wellington	21	Yokohama	89
Teleg. mat.	659		
Yokohama	3,922		
Total	£19,910	Total	£8,163

Foreign Goods Transhipped.

Colombo. Elec. cable	Value £38	Bordeaux. Elec. mat.	Value £125
Durban. Teleph. wire	308	Sydney. Elec. goods	60
Total	£346	Total	£185

Willans Engines.—The Roundwood Colliery Co., Yorkshire, have decided to install a standard Willans compound engine for direct coupling to a Wilson Hartnell dynamo for supplying power to their colliery. Messrs. Willans & Robinson, Ltd., have received an order through the Brush Co. for two 500-H.P. engines for the Corporation of Pietermaritzburg, S.A. The South Wales Electrical Power Co. have let a further order for four 100-H.P. Willans engines for direct coupling to alternators of the British Westinghouse Co.'s make for their Roath and Cambrian stations.

Electric Driving at Bessemer's.—At the meeting of Henry Bessemer & Co., held at Sheffield on 9th inst., Colonel Allen said it would be necessary to spend large sums in laying down electrically-driven plant to cheapen the cost of production.

E

Catalogues and Lists.—MESSRS. ELLIOTT BROS. have sent us illustrated lists of their alternating current measuring instruments, the Century test set, and the Century d'Arsonval galvanometer.

A circular relating to the Pitman "Hector" water motor has come to hand from Mr. PERCY PITMAN, who has recently changed his address to Bosbury, Ledbury, Hertfordshire.

We learn that the Telephone "Call" and "Reply" Register which Mr. A. C. JAMES, of Broad Quay, Bristol, has just published, and to which we have already referred, is having a rapid and increasing sale.

From the editor of *Cold Storage* we have received one of his small pocket calendars for 1903. It is practically a directory of the particular trades to whose cause the journal mentioned devotes itself.

A new catalogue (150 pages) has been published by MESSRS. GRAHAM, MORTON & Co., LTD., of Leeds. It contains an excellent collection of photographic views of coal-conveying, screening, and crushing plants, such as they have supplied to electricity supply works, tramway power stations, gas works, &c., in all parts of the country.

Mr. G. BRAULIK has issued a new illustrated catalogue and price list of motor-cars and all accessories employed in connection therewith. The "Protos" motors, variable speed gear, accumulators, electrical ignition, and measuring instruments are well illustrated. All of the above, also several types of "Protos" cars, may be seen at Mr. Braulik's showrooms in Upper Thames Street, E.C.

A circular of their automatic telephones for reply and call system has been sent to us by the BERLINER TELEPHONE MANUFACTURING CO.

MESSRS. GEIPEL & LANGE have sent us several circulars relating to their Ward-Leonard circuit breakers.

A highly coloured wall sheet of illustrations, showing cylinder dusters, has been received from AUGUST KRAUSHAAR, of Hanau a. M. (Deutschland). It is claimed to be specially suitable for cleaning dynamos, telegraph and telephone instruments, and all factory machinery.

Bankruptcy Proceedings.—A motion arising out of the failure of J. H. Redgrave, electrical engineer, 53, Regent House, Regent Street, W., came before Mr. Justice Wright last Monday in the King's Bench Division of the High Courts of Justice. The debtor was adjudicated bankrupt in 1893 at Cheltenham, in the name of G. R. R. Preston, and was shortly afterwards sentenced to a term of four years' imprisonment for forgery. He subsequently removed to London, and whilst trading as above was brought to the London Bankruptcy Court in 1902. When the latter proceedings were instituted he absconded from his Barnet residence, but was followed, and eventually arrested at Blackpool, and is now undergoing another term of imprisonment in connection with what is known as the Forged Leases case. The liabilities under the Cheltenham failure amounted to £19,000, and the trustee under last year's bankruptcy anticipates that claims of between £30,000 and £40,000 will rank against the estate. The Court was asked by the motion to order a sum of £2,920, recovered by the trustee under the London bankruptcy, to be handed over to the Cheltenham Official Receiver as forming part of the estate under the 1893 failure. After hearing Mr. Muir Mackenzie in support of the motion, and Mr. Clayton on behalf of the London trustee, the learned judge made a consent order for the latter trustee to hand over to the former a cheque for £1,000 on account, the balance to be paid after an account had been prepared and agreed of the London trustee's costs, charges, expenses and remuneration. His Lordship intimated that in the event of any questions arising as to the amount of such allowances the matter could be referred to him again.—Order entered accordingly.

Dissolutions and Liquidations.—A petition for winding up the S. M. Van Hinden Electrical Co. has been presented by Mr. G. Braulik, and will be heard at Liverpool on February 27th.

The Pioneer Power Co., of 39, Victoria Street, S.W., is winding up, with Mr. F. W. Pixley, of 53, Coleman Street, E.C., as liquidator.

Messrs. G. L. Addenbrooke and L. I. Robinson (Lionel Robinson and Co., electrical instrument makers, &c., Carteret Street, Westminster, and Bayswater) have dissolved partnership. Debts will be attended to by Messrs. Robinson & Williams-Ellis, who will continue the business under the old style.

Staff Dinners.—The inaugural dinner of the staff of Waygood & Otis, Ltd., was held on 28th ult. at the Bridge House Hotel, London Bridge, S.E. Nearly 160 members were present, including the chairman and directors, the company's agents from all parts of Great Britain, and several of its representatives from the Colonies and elsewhere abroad.

The apprentices in the electrical department of Vickers, Sons and Maxim, Ltd., held their first annual dinner at the Mason's Arms Hotel, Barrow-in-Furness. A silver cigarette case was presented to Mr. E. Kendall, who, after four years' service at the works, was leaving England to take up a position in some electrical works in South Africa. In the course of the subsequent speeches, it was stated that the staff of the department numbers 158 all told.

New Publications.—A new publication is announced by Messrs. D. N. Dunlop & Co., of Effingham House, Arundel Street, Strand, W.C. Its title will be the *Engineering Digest*, and it is intended to be a time-saver. It will be a 6d. weekly index and review of contemporary engineering literature, and will give a survey of the principal technical press of Great Britain, America and Europe.

Mr. G. R. Sims's newspaper "Men and Women"—published by Cassells—has now made its appearance. It is a penny weekly production. Its articles and news may be quite interesting and chatty, but in regard to the portrait printing—well, we have seen worse.

Books Received.—"An Epitome of Useful Information Relating to Trade Marks, Letters Patent, Designs, Copyright, and the Use of the Royal Arms," by T. B. Browne, Ltd. 1903. 2s. 6d.

"India-Rubber and Gutta-Percha," by T. Seeligmann, G. L. Torrilhon and H. Falconnet; translated by J. G. McIntosh. London: Scott, Greenwood & Co. 1903. 12s. 6d. net.

"Lathes, Screw Machines, Boring and Turning Mills," by Thos. K. Shaw. Manchester: The Scientific Publishing Co. 1903. 15s. net.

"Steam Power Plants: their Design and Construction," by H. C. Meyer, Jun. New York: McGraw Publishing Co. 1903. $2.00.

"Motoring Annual and Motorists' Year Book, 1903." London: *Motoring Illustrated*. 3s. 6d. net.

"The Rating of Electric Lighting, Electric Tramway, and similar undertakings," by W. G. Bond. London: The *Electrician* Printing and Publishing Co., Ltd. 2s. 6d. net.

Trade Announcements.—The Unbreakable Pulley and Mill Gearing Co., Ltd., have appointed Messrs. Eug. Nahman & Co., of Place Mohammed Aly, Alexandria, and Sharia Bab el Hadid, Cairo, as their agents for Egypt and the Soudan.

Messrs. Rowland Carr & Co. have entered into agreement with the patentee of Franklin's Patent Ventilated and Watertight Frame and Cover to become sole makers of these frames and covers, which are thoroughly watertight, and at the same time secure ventilation for the manhole. Messrs. Carr wish to notify that in future these frames and covers can only be obtained through them.

Messrs. Ward & Goldstone, of Manchester, have taken additional works at 45, Dutton Street, Strangeways, for the manufacture of cast-iron watertight fittings, switchboards, &c. The old works will be used solely for the manufacture of wires and cables. Messrs. A. W. Richards & Co., of 70 and 71, Bishopsgate Street Within, E.C., are the firm's London agents.

The National Electrical Co. has opened offices at 32, Bachelor's Walk, Dublin, as electrical engineers, wiremen and contractors.

Geipel Steam Traps.—We are informed that Mr. Geipel has instituted proceedings against the Corporation of Manchester and others for an injunction and damages for using steam traps which are alleged to be an infringement of the Geipel patents.

Disclaimer.—In connection with the recent prosecution of Frederick Horwood, 34, electric fitter, and others, at Marlborough Street Police Court for alleged burglary, Mr. Frederick Horwood, of 15, Coleraine Road, Hornsey, N., wishes it to be known that he is not the man referred to.

Bournemouth.—We are informed by the Alphons Custodis Chimney Construction Co. that the chimney at the Bournemouth Tramway Power Station was built on their patent system, not octagonal, but circular in plan, 8 ft. in diameter at the top, and without the cast-iron cap and stone cornice originally specified. The Alphons Custodis Co. has built over 4,000 chimneys in various countries, and has received the order for the four shafts for the District Railway power station at Chelsea—275 ft. high, with an inside diameter at the top of no less than 19 ft.

Sale.—Messrs. H. Steele & Son will, on March 4th and 5th, offer for sale electric light contractor's stock and plant of J. Worthington & Co., Hanley (in bankruptcy). See advertisement pages to-day.

The Metaphone.—The National Telephone Co. has sent us a couple of metaphones. They are handy telephone sets for use in connection with electric bell wires, bells, &c., batteries in any house or other premises, and the moderate price at which they are being sold covers the cost of fitting within a reasonable distance of any of the company's offices. The apparatus consists of two patterns of small hand combination transmitter and receiver, the one called a room metaphone, to be attached to an existing bell push at the one end, and the other called a kitchen metaphone to be attached to any ordinary existing bell, or bell and indicator board combined at the other, while no alteration is required either to push, bell, or indicator board. A detailed description of the device, which is, of course, not claimed to be new, but to be more inexpensive than others on the market, is given in an excellently got up illustrated list which the company is now issuing.

ELECTRIC LIGHT AND POWER NOTES.

Barnsley.—At the inquiry into the application of the T.C. for a loan of £6,800 for electricity extensions, the town clerk stated that the loan was required for the provision of a booster (£850), storage battery (£1,450), high-speed engine and dynamo (£3,250), foundations (£150), switchboard extensions (£325), new lighting booster (£500), potentiometer and instruments (£115), feed pump (£95), and contingencies (£65). The extensions were necessary to enable the Council to supply power to the B.E.T. Co. for the trams. The present capacity of the plant was 660 KW., and the maximum load during the winter had been 640 KW. He also intimated that another loan of £10,000 had been applied for to cover recent expenditure.

Birmingham.—The Electric Supply Committee recommends the extension of the works at Water Street station at an estimated cost of £11,500, and the borrowing of £18,231 for extensions of mains, including a sum of £8,782 overspent already.

Boksburg (S.A.).—The Health Board of Boksburg, a rising township in the East Rand, about 16 miles from Johannesburg, proposes to light the town and suburbs with electricity on the two-wire direct-current system at 250 volts, distributing by means of overhead wires. The main street is to be illuminated with 12 arc lamps, and the side streets with 16-C.P. glow lamps. The contractors are Messrs. E. H. Gellender & Co., of Boksburg and Germiston, and the contract is in the form of a concession guaranteed by the Government, by which the contractors erect the generating station, put down the plant and overhead equipment, and run the same for a period of four years, during which time they have the sole right to supply. The charges will be from the municipality for each arc lamp £3 15s., and for each 16-C.P. lamp 10s., per month; from private consumers 9d. per unit, with a minimum charge of 10s. per month. At the end of the four years the T.C. takes over the overhead equipment at valuation, and has the option of taking over the plant or of conferring further powers on the contractors to continue running it. The installation will consist of semi-portable boilers and two high-speed steam dynamos of 33 KW. each (non-condensing), and the total cost of the installation is not to exceed £4,000. The contractors have already a guaranteed load of about 50 KW, and it is highly probable that larger sets will eventually be put down.

Brentwood.—It has been decided to hold a public meeting in connection with the proposals to supply electricity in the district.

Brighton.—The T.C. has decided to light the picture and museum galleries with 22 Davy arc lamps at an estimated cost of £140 10s.

Bristol.—Reporting on the Somerset and District Electric Power Bill on Tuesday, the Parliamentary Bills Committee of the City Council stated that the whole of the city was included in the proposed sphere of the company's operations. The Bill was so drawn as to relieve the company from most of the restrictions which are usually imposed upon undertakers, and the financial arrangements of the Bill were most unusual. The Council was accordingly recommended, and resolved, to petition against the Bill.

Burnley.—The T.C. has fixed the price of energy for motors at 3d. per unit supplied at full load for the first hour per day, and 1d. per unit for any time thereafter.

Burslem.—Negotiations are proceeding between the T.C. and the Potteries Electric Traction Co. relative to a supply of energy for electric lighting purposes.

Bury (Lancs.).—The T.C. on February 5th adopted the following scale of charges for the hire of motors from June 1st next:—¼ H.P., £1 15s. per annum; ½ H.P., £2; 1 H.P., £2 10s.; 2 H.P., £3 10s.; 3 H.P., £4 10s.; 4 H.P., £5 10s.; 5 H.P., £6; 7½ H.P., £7; 10 H.P., £8; 15 H.P., £10; 20 H.P., £12 10s.; 30 H.P., £17 10s.; 40 H.P., £20; 50 H.P., £25. Hirers of motors of 30 H.P. and upwards are to guarantee payment of a sum equal to at least five annual rentals.

The T.C. has decided to apply for a loan of £10,000 for electricity purposes.

Chippenham.—The T.C. is considering an electric light scheme for the town.

Croydon.—The Corporation has received from the L.G.B. sanction to a loan of £45,403 for the purposes of electric lighting. The main items which go to make up this sum are as follows:—Two water-tube boilers with pipe work and valves, £3,500; mechanical stokers, £850; engine and dynamos, 600 KW. set, £7,000; surface condensing plant, cooling and storage pond, air pumps, &c., £7,581; direct current mains and extensions, £3,810; additional services, at £10 per consumer, £8,000; transformers, &c., £8,000. The plant will absorb £21,241, with 10 per cent. added for contingencies, while £19,810 will be spent on mains, with 10 per cent. added for contingencies.

Darlington.—The T.C. has decided to apply to the L.G.B. for a loan of £20,000 for electric lighting purposes.

Derbyshire.—The U.D.Cs. of New Mills, Whaley Bridge, Chapel-en-le-Frith and Hayfield have decided on combined opposition to the North-Western Electricity and Power Gas Bill.

Dulverton.—It has been decided to adopt a water-power scheme as the most economical method of lighting the town. Two approximate estimates of the cost had been received—from Mr. McCarthy, Manchester, at £1,730 (£280 less without storage batteries); and from the British Westinghouse Co., at £2,600—each of whom estimated a profit of 10 per cent.

East Barnet Valley.—On Friday, the 30th ult., a L.G.B. inquiry was held at New Barnet to consider an application from the U.D.C. of East Barnet Valley for a loan of £14,000 for working a prov. order for electric lighting, granted in 1899. The mains of the company supplying the adjacent district of High Barnet are on the boundary of East Barnet Valley, and offers have been made to the U.D.C. to supply energy to the area at 3½d. per unit, against 7d. proposed to be charged if the scheme of the local authority is carried out. The supply can be obtained at once, and the residents not only in the compulsory area, but also in the important residential district of Hadley Green, on the threshold of which the company's mains are also laid, can be supplied. Under these circumstances, it is not surprising that there should be a strenuous opposition both within the Council chamber, and among the ratepayers, to the Council's scheme. It appeared from the evidence that the members of the Council were about equally divided in opinion, but through the absence of one member at the critical division, a decision was arrived at in favour of the speculation, by a majority of one. Col Bentley, a resident at Hadley Green, whose house is already wired and waiting for current, at the inquiry gave evidence against the scheme. Councillor Wood said that property owners were dead against it. The only evidence in favour of the loan, except the official case of the moiety of the Council, was from a Mr. Ambler, jun., who believed that there was a possibility of the electricity being supplied at a profit. The opposition was mainly from an important section of the ratepayers, a memorial being presented to the L.G.B., signed by 752 occupiers, representing more than half the ratable value. The Barnet District Gas and Water Co. opposed as large ratepayers, and pointed out that supplying electricity at a loss would mean that the gas company, as ratepayers, would be taxed to subsidise their own competitors, and if the scheme were sanctioned the Bermondsey clause should be adopted. For the North Metropolitan Co., Mr. Offor stated that the same terms would be charged as at High Barnet, and his company guaranteed that consumers in East Barnet Valley should not pay more than 3½d. per unit as a general average under the maximum demand system at 7d. and 2d. He appealed to the Board to adopt the recent precedent of Faversham and recommend the Council to make terms with his company.

The evidence of Mr. Adams (the Council's expert) showed that even at 7d. per unit the undertaking would not yield a profit till the third year. He had no faith in the maximum demand system of charging, because there were no very large consumers in the district, and nobody would ever reach the lower rate—apparently oblivious of the fact that very small consumers, if they run their lamps beyond an average of one hour per day, reach the lower rate. Mr. Adams made no allowance in his estimates for depreciation or antiquation of the plant, and contended that it was not necessary and was not good finance. It will be interesting to see how the L.G.B. will deal with this case, which presents many and obvious reasons against the proposed speculation by the U.D.C. There is no necessity for it, because better terms and a prompter supply can be obtained from the company carrying on business in the adjoining district. The Council is divided in opinion, and a very important section of the ratepayers is opposed to the scheme. On what principle, then, can the L.G.B sanction the undertaking? If its province is to protect the interests of the ratepayers by only sanctioning an outlay when satisfied of its prudence, necessity, and its being in accordance with the desires of the inhabitants of the district, it would be impossible to approve of the transaction as presented at the recent inquiry.

Eccles.—The T.C. has received from the L.G.B. sanction to borrow £22,115 for electric light purposes.

Exmouth.—The U.D.C. has decided to carry out its agreement with Messrs. Crompton & Co. for electric lighting.

Falkirk.—The E. L. Committee has fixed Tuesday, March 3rd, for the opening of the new electricity works, when the light will be switched on throughout the town.

Gillingham.—With regard to the proposal to supply the new Naval Hospital at New Brompton with electric light, the U.D.C. has suggested to Messrs. Preece & Cardew that an agreement should be entered into between the Council and the Admiralty for the supply on a minimum period of three years. The Council has now decided to run the machinery continuously day and night.

The new Royal Naval Barracks, which has been built at Chatham, adjoining the Royal Dockyard, is to be entirely lighted by electricity. It is an enormous block of buildings, which will accommodate several thousands of bluejackets and officers.

Goole.—The U.D.C. has decided to ask the B. of T. to extend its prov. order for electric lighting for two years.

Grantham.—The T.C. has decided to put an end to its contract with the Gas Co. for public lighting at the close of the current year, with a view to having the electric light installed.

Kilmarnock.—A special meeting of the T.C. was held last week for the purpose of hearing the Vigilance Committee appointed at a recent mass meeting of the ratepayers on the subject of electric lighting and traction. The mass meeting had passed resolutions to the effect that the Council should not proceed with an electric lighting and traction scheme until it had first invited offers from private companies, that a plebiscite of the ratepayers should be taken, and that proceedings should be delayed until the next election.

Liverpool.—At a meeting of the City Council it was stated that the expenditure on general rate account for the ensuing year was estimated at £803,000, towards which the profits of the electric supply undertaking would contribute £12,000, and the tramways undertaking £25,000. The policy of taking profits from these accounts in relief of the general rate gave rise to much criticism. Mr. Armour moved that the sums in question be not transferred, but remain as part of the assets of the Corporation. He contended that the sum of £50,000 which was set aside for depreciation, equal to 2½ per cent. on the capital account, was not sufficient. They ought to hold their profits in reserve. The accumulation of reserve funds, after five years and seven months, was only £170,000. The case of the Electric Power Committee was even worse than that of the Tramways Committee, as the amount of reserve and renewal they had in hand was only equal to 1½ per cent. Mr. T. Utley seconded Mr. Armour's

amendment. The whole tramway system would, he said, within a few years, have to be practically renewed; while in the first instance, it cost £500,000, it would now cost to renew it £700,000, and it was estimated that £430 per mile per annum would be required for depreciation. Alderman Petrie, chairman of the Tramways Committee, said that since the Corporation had acquired the tramway undertaking, it had set aside £253,000 for renewals and reserve, and this sum had been obtained, and had maintained the whole system in a high state of efficiency simply out of revenue. The £25,000 from the tramways was not an excessive amount. The Committee was setting aside £51,923 for sinking fund, £50,351 for renewals, and £37,178 for reserve.

London.—ISLINGTON.—The annual report of the Finance Committee of the Borough Council was issued on Wednesday; it says:—"Whilst we are of opinion that on the whole, having regard to the increased public demands upon the funds of the local authority, the increased expenditure as compared with 10 years ago is justified, we deem it our duty to direct the attention of the Council to the item of 'Public Lighting.' Here the expenditure has gone up from £14,645 in 1893-4 to £33,314 in 1902-3. This extraordinary increase is due mainly to the introduction of electric arc lighting, and to some extent to increased gas lighting; but, as a matter of fact, even this latter figure, large as it is, does not actually represent the whole cost of street lighting. The price of 3½d. per unit which is charged for current supplied to the public electric arc lamps is really under cost price, and, of course, means a distinct loss to the electricity undertaking—last year to the extent of no less than £4,900. This means that instead of showing at the end of the last financial year a deficiency of £524, the accounts of the undertaking would, had the electricity supplied for street lighting been charged at cost price, have shown a surplus of at least £4,376, without taking into account previous years; and when it is remembered that up to the present time no provision has been made for depreciation in respect of the undertaking, the Council will understand the importance of this point from a strictly commercial aspect. The General Rate, on the other hand, would have been increased by nearly ¾d. in the £. We hope to present a report on this subject at an early date, but in the meantime we feel sure that the Council have no desire to conceal the exact position by showing the cost of street lighting at a lower figure than is actually the case, and thus cause a deficiency in the accounts of the electricity undertaking. Sooner or later provision must be made for depreciation, and we would remind the Council that if there are no surplus profits this would have ultimately to be borne by the rates. We think it would be better, therefore, that the correct figures should be shown both in the expenditure on public lighting, and correspondingly in the income of the electricity undertaking." We heartily endorse the recommendation of the Committee that the correct figures should be shown. It is a matter for regret that so many local authorities conceal the facts by distorting the figures. The Committee's remarks on the question of depreciation cannot be too widely read and laid to heart by municipalities.

STEPNEY.—The London County Council has intimated that it is prepared to advance loans to the Borough Council in respect of electric lighting and other works.

BERMONDSEY.—At the M.B.C. meeting last week the E.L. Committee reported that objections to the Borough Council's application to the B. of T. for an electric lighting prov. order for St. Olave had been lodged by the South Metropolitan Gas Co., the County of London and Brush Provincial Electric Supply Co., Ltd., and the London Electric Supply Corporation, Ltd. The gas company had been informed that consent had been given to the insertion of a clause in the present order of a similar character to that inserted in the order of 1902.

ST. PANCRAS.—The M.B.C. last week received an intimation from the L.C.C. that it is prepared to advance a loan of £20,000—part of £90,000 applied for—on account of electric light undertakings.

Lynton.—The U.D.C. has decided to ask the E.L. Co. to terminate the arc lighting agreement with the Council, which will then seek powers to distribute for itself.

Maidstone.—The Corporation E.L. Committee has adopted a flat rate of 5d. per unit for energy supplied to shops and workshops, and of 4d. for private houses and licensed premises, with the option of continuing the present maximum demand system, thus stultified.

Manchester.—A few weeks ago the engineer asked for a short leave of absence to enable him to attend the forthcoming congress of electrical engineers in Italy. The Committee acceded to the request and offered to pay his expenses. At the last meeting of the Council certain members objected to the engineer being absent from his post, and a majority of the Council supported a proposition that the Committee's minutes should be referred back for further consideration.

Middleton.—The T.C. has applied for a loan of £6,000 for extras on the electricity works.

Middlesbrough.—The T.C. has decided not to proceed with the scheme submitted by Mr. Robert Hammond for extension at an estimated cost of £21,000.

Motherwell.—A start has been made with the construction of the Clyde Valley Electricity Co.'s works. Excavations are being made for the buildings.

Nairn.—The T.C. is considering the offer made by Messrs. Crompton & Co., Ltd., to take over the prov. order for lighting the town by electricity. The T.C. would have the option of purchasing the works after 18 years.

Oxford.—The T.C. has accepted the tender of the Electric Lighting Co. to provide 11 arc lamps for public lighting. The price charged for energy is a fraction over 2d. per unit.

Paisley, N.B.—The T.C. is considering a report prepared by a consulting engineer regarding the proposed extension of the electric lighting scheme, owing to the large increase in the applications for electric light The extension is estimated to cost £42,000, and the work will comprise additional plant, improvement of mains, and a spare engine for traction. At May last the capital account of the works was £106,328.

Perth.—The T.C. on Monday, 9th inst., approved of the recommendation of the E.L. Committee to obtain a new 200-KW. steam dynamo, and to apply to the Secretary for Scotland for consent to the borrowing of £7,000 for electricity purposes.

Portsmouth.—There was no opposition at the L.G.B. inquiry on Friday into the application of the T.C. for a loan of £17,100 for E.L. purposes. The chairman of the E.L. Committee said the money was required for extension of plant to enable the Corporation to supply 6,500 lamps for the new naval barracks, 4,250 lamps at Eastney Barracks, and 2,000 lamps at the Gunwharf for the Government.

Redditch.—At a recent meeting of the D.C. a resolution was moved that it was expedient, in the interests of the town finances, to lease the E.L. undertaking, if suitable terms can be arranged. After long discussion, this was defeated, and it was eventually decided to negotiate with Messrs. Willans & Robinson for the supply of further plant.

Rhodesia.—We have received a copy of the British South Africa Co.'s report upon the present position of Rhodesia, in which the following notes appear:—"The Victoria Falls, which present a spectacle of extraordinary grandeur and beauty, will certainly attract a large tourist traffic. These falls are double the width of the Niagara Falls, and more than twice the height, being 1¼ miles in width, and nearly 400 ft. high, while the Niagara Falls are only ½ mile wide, and 158 ft. high. In order that construction may not be interrupted on the arrival of the rails at the river, it has been arranged to take the engines and other plant required for construction over the river above the falls on ponts, and to construct an aerial tram over the gorge below the falls for transporting the permanent way material. From the falls the progress will be uninterrupted to the rich mineral deposits situated in the bend of the Kafue river. With vast deposits of copper, lead, zinc and iron to the north, an inexhaustible coal supply to the south, and unlimited water power, I think the time is not far distant when advantage will be taken of these facilities for the inauguration of important industrial enterprises in the neighbourhood of the falls. A few years ago the transmission of electrical power for a distance of 50 miles was regarded as an impossibility, but to-day, in California, it is successfully transmitted nearly 300 miles; and the time is probably approaching when the enormous water-power available at the Victoria Falls will be utilised to generate electricity for transmission to the mines in Northern and Southern Rhodesia."

Sevenoaks.—As a result of negotiations the U.D.C. has signed an agreement with the Kent Electric Power Syndicate, Ltd., for a supply of energy to the town within 12 months of the receipt of its prov. order.

Standish.—The U.D.C. has resolved to apply for an extension of two years in which to carry out the prov. order for electric lighting granted in October, 1901.

Stroud.—Messrs. Medhurst & Lloyd have offered to report to the U.D.C. relative to the proposed electric lighting scheme for a fee of £10 10s.

Swindon.—The gas lamps in 14 of the principal streets of the town are to be replaced by electric lamps.

The T.C. has declined an offer to lease its electric lighting powers.

A number of the ratepayers having pointed out to the T.C. that the proposal to wire consumers' premises and supply fittings and lamps is illegal, and threatened to take steps to secure an injunction restraining the Council from this system of trading, the town clerk has taken counsel's opinion on the matter. As a result, the Lighting and Tramways Committee has recommended the Council not to proceed with the wiring and fitting scheme until the necessary powers to enable it to do such work are obtained, and all the minutes and resolutions relating to the matter have been rescinded.

Walsall.—The report of the Electric Lighting Committee shows a loss on the year's working of £244. At very short notice the Committee had to undertake the driving of the trams, which necessitated putting down new plant; this and other things militated against the undertaking producing a profit. The capital invested has increased from £43,329 to £56,540, by 30 per cent., but the income has only increased by 17 per cent.

West Hartlepool.—The T.C. has received permission from the L.G.B. to borrow £7,107 for E.L. extensions.

Whitehaven.—Four electric arc lamps are to be erected on the dock quays by the Harbour Commission as an experiment.

Wimbledon.—A L.G.B. inquiry was held on February 5th relative to the application of the U.D.C. for a loan of £1,850 for E.L. purposes; there was no opposition.

ELECTRIC TRACTION NOTES.

Blackburn.—The T.C. on February 5th decided to pay £750 to Messrs. Dick, Kerr & Co., Ltd., for forfeiture of a contract on tramcars. It was explained that the cars were ordered in consequence of a projected extension of the tramways, which was not carried out owing to losses on the system.

Bournemouth.—The Board of Trade withheld consent for working the Richmond Hill, Poole Hill, and the Triangle routes until track brakes had been fitted to the cars. Such brakes are accordingly to be fitted to 30 cars, at £60, and to all new cars. 16 new cars have been ordered from the British Westinghouse Co., to be completed in 18 weeks.

Cardiff.—The suggested reconstruction of all the tramway lines between Splottlands and Georgetown, two of the most important suburbs, has been deferred, pending official reports on certain specific issues.

Croydon.—The Corporation having objected to Mr. Monkhouse, who had supervised the conversion of the tramways, being paid a further £150 to take charge of the work in connection with the extension from the present terminus at South Norwood to the Penge boundary, on the ground that Mr. Scott, the borough electrical engineer, can do the work, the Tramways Committee has given way on that point, and the work will now be carried out by the borough electrical engineer and the borough surveyor conjointly.

Durham County.—On the 6th inst. a start was made at Fence Houses with the Houghton-le-Spring and District Tramways. The lines are being laid down by the United Kingdom Electrical Tramways Syndicate, of London, and Mr. J. G. Kirtley, of Sunderland, has the contract for the first section of the work. The lines will connect all the chief villages and small towns in the district. The whole length of the routes comprises about 18 miles of tramway. The method of propulsion is that of the overhead electrical system, and the site of the generating station is at Philadelphia. In addition to passengers, goods traffic will be dealt with. The civil engineers are Messrs. David Balfour & Son, of Houghton-le-Spring and Newcastle, associated with Messrs. Handcock & Dykes, of Newcastle-on-Tyne and London. The United Kingdom Syndicate, which owns a number of tramway schemes, is stated to have disposed of the Houghton system as well as the Leeds suburban system on their completion to the Ito Syndicate, London.

G.N. and City Railway.—In the London Courts on 6th inst., a Mrs. Dawson, carrying on a drapery business in the City Road and East Road, claimed to recover from the Great Northern and City Railway damages said to amount to some £10,000 for injury to her premises, and consequent loss in her business, caused by the tunnelling work carried on by the company for the purpose of constructing its tube railway. The jury returned a verdict for the plaintiff for £4,150.

Huddersfield.—On Wednesday, 11th inst., a large company assembled by invitation of Councillor T. H. Moore, chairman of the Huddersfield Corporation Tramways Committee, at the power station, Longroyd Bridge, to witness the starting of a new 1,300-H.P. vertical cross-compound engine built by Messrs. Combe, Barbour, of Belfast. The ceremony was performed by Mrs. Moore, and Mr. Barbour, senior partner of the makers' firm, presented her with a massive silver bowl. From the first the Huddersfield tramway system has been operated by the Corporation—that is, since 1883, and prior to the introduction of electric traction, mechanical power was used, in the form of steam propulsion. The length of route now equipped electrically is about 28 miles, with 61 cars, and a total mileage of 118,600 car-miles per month. The generating station was at first equipped with three Lancashire boilers by Messrs. Taylor & Son, of Marsden. To these has been added a fourth, and mechanical stokers are fitted throughout. Four batteries of Green economisers are employed. The engine house contained originally two engines of 650 H.P. by Messrs. Musgrave, of Bolton, each driving an electric generator by Messrs. Greenwood & Batley. To these a third set has been added, the engine being by Messrs. Combe, Barbour, and the generator by Messrs. Mather & Platt, of Salford. The engine is capable of giving 1,000 I.H.P. continuously, and 1,300 for short periods, at a speed of 90 revolutions per minute, and has a massive fly-wheel of about 38 tons weight. It will be seen that the engine power has been doubled by the recent extensions. A special feature of the station is the provision of a number of boosters, each driven by an electric motor. The original switchboard was 13 ft. 10 in. long, but with the extensions which have been made by Mr. Bertram Thomas, of Manchester, it now measures 36 ft. in length, and presents an exceedingly workmanlike and handsome appearance. Forty-one new cars have been added, made by the British Electric Car Co., Manchester, bringing the total number up to 61, as before stated. These have been fitted with slipper brakes, and everything has been done to render their operation as safe as possible on the heavy gradients. With regard to overhead wiring in the first sections of the tramways which were equipped, that work was entrusted to Messrs. Greenwood & Batley, with the B.T.H. Co. as sub-contractors, whilst Messrs. R. W. Blackwell & Co. had the contract for the Longwood route. For the extensions recently completed the contract has been executed by Messrs. Macartney, McElroy & Co. The construction of the permanent way has been carried out by Mr. Edmund Nuttall, of Manchester. The feeder cables have been supplied by Mr. Bertram Thomas, the steam pipes by Messrs. Babcock & Wilcox, and the mechanical stokers by Messrs. Vicars. The particulars of mileage, number of cars, passengers carried and cost per mile under both systems of traction are as follows:—

	1898.	1902.
Car-miles run, January	37,147	118,601
Passengers, January	389,968	821,180
Average speed of cars in miles per hour, January	8	8
Cost per car-mile...	15·67	10·97

The cost of energy generated in January, 1903, was ·252d. per unit, a very low value.

Inverness.—Messrs. Fraser & MacCullum, solicitors, have obtained the assent of the Council to the laying down of a tramway from the railway station to Kessock Ferry, a distance of a mile, as part of a scheme for meeting the traffic of the town. Steps will be taken to form a syndicate.

Italy.—The Government has approved the scheme for a narrow gauge electric railway between Voghera, Rivanazzano and Varza.

Johannesburg.—The T.C. on January 12th adopted the report of the Tramways Committee recommending an electric power, light, and tramways scheme, involving a capital outlay of £1,290,000.

Johnstone.—The plans of the scheme for connecting Johnstone and Paisley, N.B., by means of electric tramways were last week considered by the Johnstone T.C.

King's Norton and Northfield.—The U.D.C. has retained Mr. C. H. Gadsby as tramway engineer.

Leeds.—The T.C. has decided to apply to the B. of T. for a loan of £350,000 for electric tramway purposes.

London.—ST. PANCRAS.—It is stated that by a small majority the Borough Council has refused to consent to tramways in Tottenham Court Road.

L. C. & D. Railway.—The following comments, made by the chairman of this company last week, are quite characteristic of Mr. J. Staats Forbes:—"Everyone was mad on electricity. They were all going to be electrified. He had no doubt that all companies would have to face the electrification of at least portions of their lines. This was especially the case in portions in and about London. Mr. Yerkes stated that what cost the companies 50 per cent. now to move would cost them 25 per cent. They could see that if they could supply the public with ease and comfort at half the present price, they would be sure to gain. They were, therefore, taking the necessary steps in Parliament."

New York.—The Metropolitan Street Railway Co. will expend $4,500,000 during the present year on improvements. These will include the equipment of old horse lines with the underground conduit system, and the conversion of the present storage battery line on 34th Street to the same method of propulsion.

Newcastle-on-Tyne.—A site for car sheds has been purchased by the T.C. for £2,265.

An agreement has been entered into between the T.C., Walker U.D.C., and the Newcastle Electric Supply Co., Ltd., relative to the supply of electricity for the Walker tramways. The T.C. will require 345,000 units per annum for the cars, 146,000 units for lighting, and 58,400 for working the machinery. Originally the sum to be paid was 1¼d. per unit for part of the supply, and 1d. for another part, with $1\frac{1}{10}$d. per unit for lighting. Now it has been agreed that £1,500 shall be paid in 1905, and a lesser sum in 1903 and 1904.

Paisley.—The engineer to Mr. Murphy, the promoter of the Paisley electrical tramways, on Thursday, 5th inst., deposited copies of his working plans with the Master of Works prior to their being considered by the T.C. It is expected that the first section of the system will be in operation in the summer of 1904.

Rotherham.—On January 31st two sections of the Corporation tramways were opened by Alderman Winter, chairman of the Tramways Committee. Alderman Winter said that the scheme, when complete, will be one of 8 miles, including a connection with the Sheffield system. The contracts entered into amount to £92,000, but with the addition to the generating station the total will just exceed £100,000.

Sale.—The decision of the U.D.C. of Sale in handing over the working of the tramways in the district to the B.E.T. Co., Ltd., was the subject of a long and at times lively discussion at the last monthly meeting. It was resolved to call a ratepayers' meeting.

South-East Lancashire and Traffic Arrangements.—An arrangement took effect at the beginning of the present week between the Great Central Railway Co. and the South Lancashire Tramway Co., by which passengers and parcels are booked through by the electric cars of the latter company from Leigh to St. Helens, Wigan, Manchester, and other places. The traffic is conveyed by car to Lowton St. Mary's, on the Great Central line, and thence by that company's trains to its destination. It is said to be the first working arrangement between an electric tramway company and a railway company.

Swansea.—The T.C. has decided to invite the representatives of the Schuckert Co., the Dolter Co., and the Traction Co. for the United Kingdom to meet the Electric Committee relative to the proposed surface contact system for the tramways. For laying down a mile of track on the straight for experimental purposes, the Schuckert Co. quotes £10,500, the Dolter Co. £7,355, and the Traction Co. £9,904.

Sunderland.—On 3rd and 4th insts. the Corporation tramway employés sat down to dinner at the Palatine Hotel, Mr. Harry England, the general manager, presiding.

Walsall.—The Tramways Committee has appointed a Sub-Committee to consider and report as to what arrangements should be made for efficiently managing the tramway undertaking by the Corporation on the expiration of the present lease.

Whitefield.—A loan of £13,461 has been applied for by the U.D.C. for the construction of electric tramways along the Bury New Road.

Wolverhampton.—Our correspondent says: "It would almost seem as if the Town Council, or at any rate, the members of the Tramway Committee had made up their minds that the Lorain surface contact system of electric traction is to be finally adopted. At the Council meeting on Monday the tender of that company, amounting to £1,741, for the supply of special work in connection with the crossings and points required in the new tramway routes proposed to be next constructed, was accepted. At the same meeting accounts were passed sanctioning payment to the company of £1,887 6s. for tramway trucks and electric equipment (on account), and also another sum of £41 for altering gears of tramways. The Council have passed a resolution to the effect that an insurance be effected with the Ocean Accident and Guarantee Corporation, Ltd., to cover the liability of the Corporation in respect of accidents caused by the tramcars."

TELEGRAPH AND TELEPHONE NOTES.

American Telephones in Germany.—The German post office authorities are said to have ordered 20,000 automatic telephones of American manufacture, as a result of recent experiments.

Chinese Telegraphs.—A Reuter despatch from Shanghai says that the Government has again decided to assume control of the Chinese telegraphs, with the idea of preventing official secrets from becoming known to foreigners.

The Constantinople—Odessa Cable.—The *Times* correspondent at Constantinople says that the concession held by the Eastern Telegraph Co. for the cable between Constantinople and Odessa will expire in June next, and Russia is already taking measures to obtain the reversion of the company's rights.

A later dispatch says that Russia has made a proposal for the joint working of the line by Russia and Turkey.

Danish-German Telephones.—Telephonic communication was established on the 3rd inst. between Copenhagen and Frankfort and Mayence, a distance of about 400 miles.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1900	
Trinidad-Demerara No. 1	Aug. 27, 1900	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
St. Lucia-St. Vincent	Nov. 18, 1902	
Martinique-Puerto Plata	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Reissi-Issa-Reissi-Yemani	Oct. 22, 1902	
Cadiz-Teneriff	Nov. 8, 1902	
St. Jacques-Haiiphong	Jan. 3, 1903	
Falmouth-Bilbao	Dec. 18, 1902	Feb. 6.
Jamaica-Colon	Dec. 31, 1902	
Sitvebondo-Bandjermasin	Jan. 25, 1903	
Marseilles-Barcelona	Jan. 28, 1903	
Marseilles-Bone (both cables)	Feb. 3, 1903	Feb. 4.
Landlines:—		
Route to Tientsin and Taku *via* Helampo	June 18, 1900	

Wireless Telegraphy.—Major Harrison arrived at San Juan, Porto Rico, on January 22nd, for the purpose of superintending the erection of a wireless telegraphic station for the De Forest Wireless Telegraph Co.

Our New York correspondent sends us the following item, which is especially interesting because of Mr. Marconi's latest explanation of the delay:—"Signor Marconi was the guest of the Metropolitan Club, New York, at a dinner on Saturday, January 24th, the invitations being issued by the Marconi Wireless Telegraph Co., of America. Signor Marconi, in replying to the toast of his health, said that most of the delays he experienced in getting his trans-Atlantic system into working order were due to the fact that one half of the machinery was in Cornwall, and instructions from one end to the other had generally to be sent by mail." It is, indeed, curious that a royal message should be able to get through at all. Mr. Marconi has used the cable for some things, why not for others?

The Marconi Wireless Telegraph Co. is said to be preparing to take action for alleged infringement of patent rights against Mr. De Forest, a New York inventor of a system of wireless telegraphy, which has been used experimentally in sending "tape prices" from the Stock Exchange to the Press agencies.

When Mr. Marconi landed at Liverpool on Saturday he was, of course, interviewed, and the *Times* reported that he informed a Press representative that King Edward's reply to President Roosevelt "was received at the other side by wireless telegraphy and not by cable as had been reported." Mr. Marconi later wrote to the *Times* to correct this statement, which he says was the result of a misunderstanding on the part of the Press representative referred to. The King's reply was sent by cable.

We must confess though that it is somewhat strange that the *Liverpool Daily Courier* representative should have been so dense as Mr. Marconi would make out. Mr. Marconi ought not to have spoken until he had conferred with his London office. In the course of the interview the following conversation passed:—

"Can you tell me if the arrangements for sending off President Roosevelt's message to King Edward were carried out without a hitch?

Yes, certainly they were. Everything passed off very well.

And what about King Edward's wireless message to the President?

That was received by the wireless apparatus at the other side.

Then it is not true, as has been said in England and elsewhere, that the King's reply to the President of the United States was sent by cable?

No, it was not so. The message was received in the ordinary way. That is, of course, by wireless telegraphy.

Well, what have you got to say about the individuals who carefully circulated these reports?

All I can say is that what is good enough for King Edward of England ought to be good enough for them."

To another interviewer on his arrival at Liverpool, Mr. Marconi said:—"In about three months I believe the public will be able to take their message into an office and *ask* that they shall be sent across the Atlantic by wireless telegraphy." We have *asked* for independent and responsible experts to be allowed to investigate for themselves what is being done in trans-Atlantic wireless telegraphy; but *asking* and receiving are not quite the same thing. Mr. Marconi is further reported as saying that he did not care to discuss whether the King's message was genuine or not. "Does any one suggest that we should try to deceive the King of England?" We heard it asked the other day at a telegraph company's meeting, "Is it likely that red-tape would stop a message from the King?" This was, of course, in reference to the curious statement about a closed post office frustrating the Marconi plans.

Perhaps the most amusing of Marconi's many references to this subject are those contained in an interview with the *Daily Express*, headed "Marconi's Views," "Post Office bar the way to progress," "The King's Message." In this connection we would ask the wireless company one plain question—In what way were the Postal Authorities responsible for the company's failure to transmit the King's message from this side, and in what way would the free use of the postal system have enabled it to remedy that failure?

As to the excuse given by Mr. Marconi, messages exchanged between Potentates on the inauguration of any new system are never transmitted under urgent conditions as regards speed, but simply as a seal, as it were, to its success. This success would have been evidenced by not having recourse to the cable, but by waiting for a few hours, and then transmitting the King's message by "Wireless" An explanation of the slight delay could have accompanied the message. This course would have been more respectful to his Majesty, and would have saved the reputation of the company. Mr. Marconi threatens that he will build no more great power stations in this country. If by that is meant that he, or rather the company whose employé he is, is unlikely to secure the support of the investing public for any further such installations, until the company has publicly afforded proof that with the present installation at Poldhu, the public requirements can be honestly fulfilled, we think he is right. In the meanwhile, the world at large would think better of them and better of their system, if they came forward, and frankly owned to failures instead of attempting to throw dust in the eyes of the public by implying against a great Government Department antagoniam and unfair treatment.

Mr. Henniker-Heaton and Sir J. Wolfe Barry have been crossing swords in the *Times* with reference to the statements of the latter at the Eastern Telegraph Co's meeting. Mr. C. Bright interposed, and in one of his statements said that Mr. Henniker-Heaton was a director of Marconi's Wireless Telegraph Co. We had thought that this was quite correct until Mr. Heaton replied to Mr. Bright to the effect that he had declined the honour and had never attended a meeting of the company. He was elected during his absence in Australia several years ago, but declined the honour, as he had also declined directorships of two cable companies in order that he might hold a brief for the public and the public alone.

The Marconi Co. has submitted proposals to the Australian Commonwealth Government for the connection of Australia and New Zealand by wireless telegraphy. The cost of establishment is placed at £47,270 as against £200,000, the cost of a cable. The Commonwealth Government had instructions not to entertain proposals from the company without first consulting with the Imperial Government.

At the Royal Scottish Society of Arts, on Monday, Mr. Francis G. Baily, M.A., of the Heriot-Watt College, delivered a lecture on "Wireless Telegraphy." He contended that the utmost wireless telegraphy could do in work across the Atlantic would be to supplement one single cable, and that would render wireless telegraphy impossible

over the whole of the continent of Western Europe and the North Atlantic, whereas if it were restricted to the use of shipping it would be of enormous advantage. He thought that was a sufficiently important field for wireless telegraphy without competing with what was being done much better in other ways.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—It has been decided to invite tenders for one 420-kw. set of additional generating plant (estimated cost £5,625).

Austria.—March 10th. Tenders are being invited until March 10th by the Austrian State Railway authorities at Lemberg for the supply and erection of a complete plant for the electric lighting of the railway station at Lemberg. Tenders are to be sent to Die K. and K, Staatseisenbahn Direction, Lemberg, whence particulars may be obtained.

Barking.—March 20th. Overhead equipment, poles, feeder cables, &c. See "Official Notices" to-day.

Battersea.—March 2nd. Coal stores, carbons and meters. See "Official Notices" to-day.

Bedford.—February 25th. 500-kw. steam alternator. See "Official Notices" to-day.

Belgium.—March 5th. Tenders are being invited until March 5th by the municipal authorities of Ghent, for the concession for the electric lighting of the town. Tenders are to be sent to L'Hotel de Ville, Ghent, whence particulars may be obtained.

Bermondsey.—March 2nd. Carbons, electricity meters, indicators, fuses, oil, incandescent lamps, cables, stores, &c., for 12 months. See "Official Notices" to-day.

Bexhill.—February 21st. 300-kw. steam dynamo, water-tube boiler, superheater and crane. See "Official Notices" February 6th.

Bulawayo. — February 26th. Establishment and working of an electric tramway. See "Official Notices" Nov. 21st.

Burnley. — February 23rd. Cables for lighting and tramway extensions. See "Official Notices" February 6th.

Bury.—February 27th. Tramway poles, overhead line, section boxes, &c. See "Official Notices" to-day.

Chester.—February 28th. 150 electricity meters. See "Official Notices" to-day.

Colchester.—February 17th. Condensing plant and air and circulating pumps. See "Official Notices" January 30th.

Edinburgh.—February 16th. Electric light fittings for Colinton Mains Hospital. See "Official Notices" January 23rd.

Exeter.—February 19th. Doulton conduits, and two-phase feeder cables, for electricity supply. See "Official Notices" January 30th.

Germany.—February 18th. The State Mining authorities at Königsberg are inviting tenders until February 18th, for the supply of four electric travelling cranes and an electrically-operated turntable. Particulars may be obtained from, and tenders are to be sent to, Die Piefbauamt., Königsberg, Prussia.

Glamorgan.—February 17th. Tenders are invited for the supply at the Parc Gwyllt and Angelton Asylums, near Bridgend, Glamorgan, of a number of complete electric motor installations (two-phase alternating). Applications for specifications to be received by the 14th inst. by W. E. R. Allen, Clerk of the Committee of Visitors, Glamorgan County Offices, Cardiff.

Gt. Yarmouth.—February 17th. 300-kw. steam alternator. See "Official Notices" January 30th.

Kingston-upon-Hull.—February 18th. Supply of all accessories, &c., for a complete telephone system. See "Official Notices" January 30th.

Kingston-upon-Hull.—February 26th. Two Lancashire boilers, coal conveyor, stokers, &c., and fuel economiser. See "Official Notices" February 6th.

Koloszvar (Austro-Hungary). — March 10th. The Municipal authorities of Koloszvar, Austro-Hungary, are prepared to consider tenders for the installation of an electric power station for the supply of motive power. Estimates are to be based on carrying out the enterprise at the expense and risk either of the town or of the would-be concessionnaires, and should be addressed to the municipality in question, at Matyaskiraly, No. 1, I. 5, Koloszvar.

Manchester.—February 14th. The Tramways Committee invites tenders for the supply of overhead equipment, tools, &c.

Manchester.—February 16th. The Tramways Committee invites tenders for copper trolley wire, galvanised steel span wire and thimbles for overhead equipment.

Metropolitan Asylums.—February 25th. The M.A. Board wants tenders for electric fire alarm installations at Eastern and Western Hospitals. See "Official Notices" to-day.

Oldham.—February 24th. The Electricity Committee wants tenders for the supply, delivery and erection of cooling towers, motor-driven centrifugal pumps, motors, and switchgear, pipework and overhead travelling crane, comprised in specification No. 10.

Rathmines.—February 24th. Coal, electricity meters, carbons, stores, &c., for 12 months. See "Official Notices" to-day.

Southampton.—February 14th. The Ordnance Survey Dept. wants tenders for four 7½-b.h.p. motors, and four starting switches and resistances. See "Official Notices" January 23rd.

Southwark. — February 18th. Electric wiring for the New Town Hall extension. Specifications from the borough engineer, Vestry Hall, 31, Borough Road, S.E.

Stalybridge, &c.—February 19th. The Electricity Board invites tenders for super-structure of new electric power station at Stalybridge.

Stockport.—February 28th. The Tramways Committee invites tenders for laying permanent way of their electric tramways.

Sunderland. — February 27th. Surface condenser, induced draught fan, battery and booster, and piping. See "Official Notices" Febauary 6th.

Warrington.—March 4th. Water-tube boilers and pipework, two 750-kw. steam dynamos, switchboard extensions. See "Official Notices" February 6th.

Wimbledon.—February 25th. H.T. switchboard and gallery. See "Official Notices" to-day.

CLOSED.

Atherton.—The U.D.C. has accepted the following tenders for supplies to the new electricity works:—Ferranti, Ltd., for switchboards; the Electric Construction Co., Ltd., for transformers; Callender's Cable Co., for cables, &c.

Central London Railway.—The British Thomson-Houston Co., of Rugby, has secured the contract for the electrical apparatus for the Bond Street extension of the Central London Railway, which will consist of the following:—Two 900-kw. rotary converters, one 100-kw. rotary converter, six 300-kw. water-cooled oil transformers, three 35-kw. oil-cooled transformers, one 120-kw. booster set. All high tension and low tension switchboards. The above will be of their well-known standard types, somewhat similar to what are at present installed in the power station and sub-stations of the C.L.R.

The contractors for the electric cables, the National Conduit and Cable Co., have accepted the tender of Messrs. Rowland Carr and Co. for the whole of the cast-iron cable hangers and bolts required for the above contract.

Colchester.—On February 4th the T.C. accepted the tender of Messrs. Mather & Platt, Ltd., for the supply of a dynamo at £850; that of Messrs. Davey, Paxman & Co., Ltd., for an engine for the electricity works, at £1,359; and that of Messrs. Stanford and Co., for a cast-iron water tank at £142 10s.

Hammersmith.—On Wednesday the Borough Council decided to order six 50-kw. transformers from the present contractors, the British Electric Transformer Manufacturing Co., at £90 each.

Ilford.—The U.D.C. has accepted the tender of Messrs. W. H. Allen, Son & Co., Ltd., for the supply of natural draught cooling tower, condensing plant, &c., at the electricity works, at £3,000.

Liverpool.—The T.C. on February 5th accepted the tender of Messrs. Willans & Robinson, Ltd., of Rugby, for the supply of two steam dynamos at £1,971 each; and that of Messrs. D. Bruce Peebles & Co., of the Tay Works, Bonnington, Edinburgh, for plant at the Garston destructor station at £1,052.

London.—The Charing Cross and Strand Co., Ltd., have placed an order for "Peard" patent junction-box fuses with Messrs. Veritys, Ltd., for their West-End undertaking, and a similar order has been placed with the same firm by the Charing Cross & City Co., Ltd., for the City undertaking.

Newcastle-on-Tyne. — The T.C. has accepted the following tenders for supplies in connection with the electric tramways:—Messrs. Thos. Beeley & Son, for four boilers at £2,810; Messrs. Cruse & Co., Manchester, for 12 superheaters, at £3,000; Messrs. Mather & Platt, Ltd., for pumping plant.

St. Annes.—The U.D.C. has accepted the tender of Messrs. Snowden & Co., for the supply of 50 street service boxes at 15s. each.

St. Pancras.—The Borough Electricity Committee has accepted the tender of Rowland Carr & Co. for a test truck.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board on February 5th accepted the tender of Messrs. Goodbrand & Co, for the supply of a fuel economiser for the generating station; that of the British Insulated and Helsby Cables, Ltd., for supplying drawing into stoneware conduits, and connecting up three-phase continuously insulated, lead-covered cables; and that of Messrs. W. T. Glover and Co, Ltd., for a complete system of tramway feeders and a lighting network in each of the four areas.

Stepney.—The Electricity Committee recommends that the tender of Messrs. Dick, Kerr & Co. for the supply of a steam dynamo and fittings for the sum of £4,188 be accepted.

The following were the six lowest tenders received for the set, which is a 500-kw. Willans steam dynamo:—

International Electrical Engineering Co. ..	£3,905
British Electrical Plant Co., Ltd., N.B.	4,108
General Electric Co., Berlin	4,149
British Schuckert Electrical Co.	4,154
Lahmeyer Electrical Co., Ltd.	4,170
Dick, Kerr & Co, Ltd.	4,188

The tender of the British Electrical Plant Co. did not strictly comply with the engineer's specification.

Walsall.—The Tramways Committee of the Corporation have accepted the tender of the Brush Electrical Engineering Co., Ltd., for the supply of 28 cars at £527 each. The Electric Lighting Committee have accepted the tender of Messrs. Callender's Co. for the laying of cables to certain sub-stations, and for several extensions.

FORTHCOMING EVENTS.

Friday, February 13th.—At 5 p.m. Physical Society. Annual general meeting at Burlington House.

At 2.30 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Electrical Power Storage Co.'s works, Millwall, E.

At 8 p.m. Institution of Electrical Engineers (Dublin Section). Paper on "Some Notes on the Electric Lighting of Rathmines," by G. F. Pilditch.

Saturday, February 14th.—At 7 p.m. Junior Institution of Engineers. Annual Dinner at Hotel Cecil.

Monday, February 16th.—At 8 p.m. Institute of Marine Engineers. Paper on "Fuel Testing Experiments."

Tuesday, February 17th.—Institution of Electrical Engineers (Manchester Section). Paper by Mr. J. S. Highfield.

At 8 p.m. Institution of Civil Engineers. Paper (if time permits) by G. F. Zimmer, on "Mechanical Handling of Material."

Wednesday, February 18th.—At 7.30 p.m. Institution of Electrical Engineers (Students' Section) Paper by Mr. A. G. Ellis on "The Paralleling of Alternators."

Thursday, February 19th.—At 4.30 p.m. Tramway and Light Railways' Association. Annual meeting at Caxton Hall.

Friday, February 20th.—At 9 p.m. Royal Institution. Mr. E. H. Griffiths on "The Measurement of Energy."

At 3 p.m. The Institution of Electrical Engineers (Students' Section). Visit to the Board of Trade Electrical Standards Laboratory.

Saturday, February 21st.—At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. J. Andrews on "Water in Steam."

At 3 p.m. Junior Institution of Engineers. Visit to the East Greenwich Works of the South Metropolitan Gas Company.

Friday, February 27th.—At 3 p.m. The Institution of Electrical Engineers (Students' Section). Visit to the Board of Trade Electrical Standards Laboratory.

Saturday, February 28th.—Annual Corps dinner of the Electrical Engineer Volunteers at the Trocadero Restaurant.

NOTES.

Crowded Out.—Owing to extra heavy pressure upon our space, we have been compelled to hold over until next week several letters intended for our "Correspondence" columns.

Motor Racing Track.—There is a movement on foot to establish a world's motor racing and testing track at Clacton-on-Sea. A meeting of those interested was held at the Crystal Palace last week. The secretary is Mr. W. G. George, 61, Chancery Lane, E.C.

The M.E.A. Convention.—The provisional programme of the eighth annual convention of the I.M.E.A. has been issued by the secretary, and reads as follows:—

Wednesday, July 15th.—Meeting at Sunderland.

Morning.—Reception of the President and members of the I.M.E.A. by the Mayor of Sunderland at 10 a.m., followed by a general meeting, at which the President will give his address, and papers will be read and discussed.

Afternoon.—Visits to the electricity stations and tramway carsheds and shipyards and engine works on the Wear.

Thursday, July 16th.—Meeting at Newcastle.

Morning.—Reception of the Association by the Mayor of Newcastle at 10 a.m., followed by a general meeting for the reading and discussion of papers.

Afternoon.—Visits to the Corporation's tramway power house; Tyneside Power Co.'s station, Wallsend; and various works electrically equipped. It is hoped that some portion of the North-Eastern Co.'s electric lines may then be complete.

Friday, July 17th.—Meeting at Middlesbrough.

Morning.—General meeting for the reading and discussion of papers.

Afternoon.—Visits to various places of electrical interest in Middlesbrough and Stockton.

Saturday, July 18th.—Meeting at Sunderland.

The annual general business meeting will be held in Sunderland on Saturday morning.

Papers to be read during the Convention.

Papers by Chairmen of Committees have been promised on the following important subjects:—"The Influence of Capital Charges on the Cost of Electricity Supply," "The Relation of Small Local Authorities to the Power Distribution Companies," "Methods of Stimulating Demand."

There will also be papers by engineers on important technical subjects, including, probably:—"Future Economies in Electrical Illumination"; "The Economical Driving of Workshop Machinery by Electricity."

London Traffic.—The Royal Commission has now been appointed to inquire into the means of locomotion and transport in London, and to report:—

(*a*) As to the measures which they deem most effectual for the improvement of the same by the development and inter-connection of railways and tramways on or below the surface, by increasing the facilities for other forms of mechanical locomotion, by better provision for the organisation and regulation of vehicular and pedestrian traffic, or otherwise; and

(*b*) As to the desirability of establishing some authority, or tribunal to which all schemes of railway or tramway construction of a local character should be referred, and the powers which it would be advisable to confer upon such a body.

The following are the names of the Royal Commissioners:—

Sir David Miller Barbour, K.C.S.I., K.C.M.G., chairman.
The Earl Cawdor.
The Viscount Cobham.
The Lord Ribblesdale.
The Right Hon. Sir Joseph Cockfield Dimsdale, Bart., K.C.V.O., M.P.
Sir John Poynder Dickson-Poynder, Bart., D.S.O., M.P.
Sir Robert Threshie Reid, G.C.M.G., K.C., M.P.
Sir Francis John Stephens Hopwood, K.C.B, C.M.G, Permanent Secretary to the Board of Trade.
Sir John Wolfe Barry, K.C.B, F.R.S.
Sir George Christopher Trout Bartley, K.C.B., M.P.
Charles S. Murdock, Esq., C.B.
Felix Schuster, Esq.
George Gibb, Esq.

Mr. Lynden Livingston Macassey, B.A., B.Sc., Barrister-at-Law, will act as secretary.

Chatham Electrical School (Royal Engineers).—The military authorities connected with the Royal Engineers at Chatham, have a scheme on hand for providing a new electrical school at Brompton Barracks, in the room of the present school now stationed at St. Mary's Barracks. It will in all probability be a commodious building erected just outside the Royal Engineer Institute. Of course, a scientific corps like the Royal Engineers has need to be fully abreast of the times in connection with all their classes, and especially is this so with regard to electricity, which now takes so prominent a place in the education of the "Sappers." It will be remembered that Chatham is the headquarters of the Royal Engineers, and the School of Military Engineering is attached to the Brompton Barracks of the Corps. Every officer of the Service (no matter what branch) has to pass through scientific classes at the Royal Engineer School of Military Engineering.

North-East Coast Engineering Trade.—The *Times* says that the members of the National Amalgamated Union of Labour, employed in the engineering works of the north-east coast, have accepted the modified terms of the employers for a reduction in wages—viz., 1s. per week off time rates of 25s. per week and over, and 6d. off wages under 25s., and 2½ per cent. off piece rates. There is to be no reduction off wages of 20s. and under and no further general change in wages for six months.

Lecture.—Sir Oliver Lodge lectured on 6th inst. at Bedford College on "Electricity and Matter."

(*Continued on page 276.*)

THE WITTON WORKS OF THE GENERAL ELECTRIC COMPANY, LIMITED.

OUR readers will remember that in October, 1900, the General Electric Co., Ltd., which had then been in existence for 20 years, and had established large factories at Manchester, Birmingham and London, found itself in need of greatly extended accommodation for the purposes of its wide range of manufactures. It was decided to reconstruct the company, and to raise additional capital in order to lay down a large central establishment wherein its manufacturing operations could be carried on with economy and convenience, while at the same time facilities for future extensions in all branches of the business could be amply provided for.

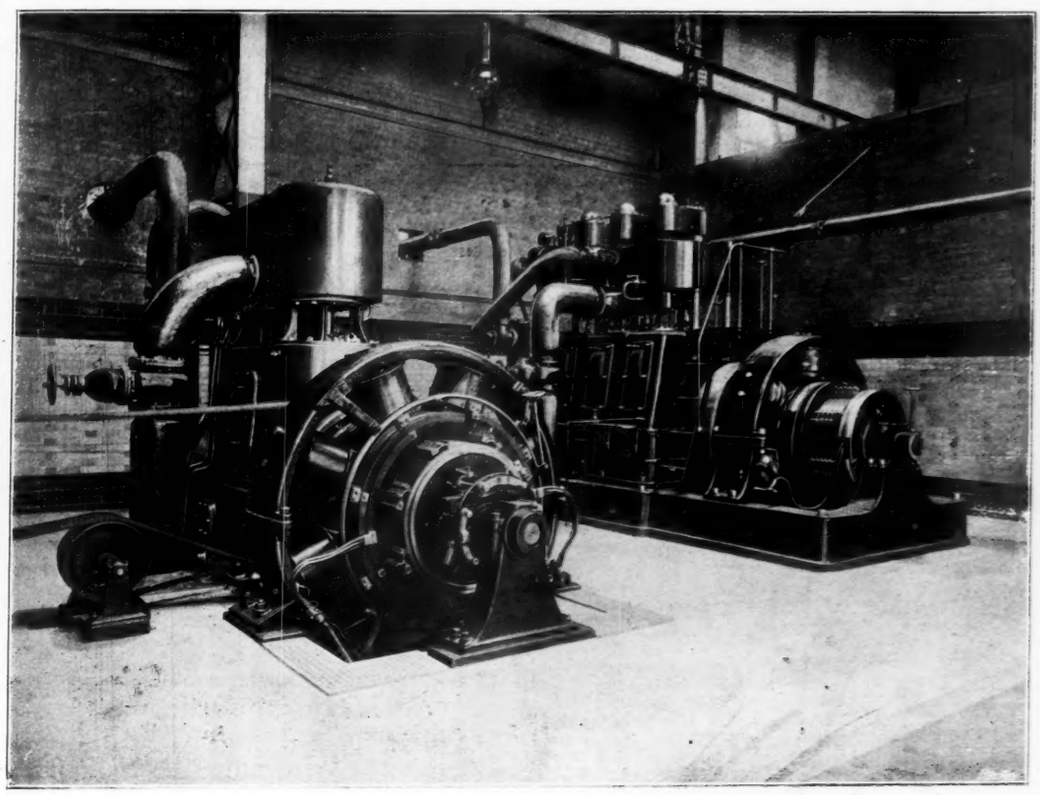
With this object the General Electric Co. (1900), Ltd., was formed, to acquire the business and assets of the existing company, and the public were invited to participate in the venture, the nominal share capital being increased to £800,000. The issue was over-subscribed, and the directors went to allotment. A piece of land of about 100 acres was purchased at Witton, three miles from Birmingham; this is traversed by the Tame Valley Canal, which divides the site into portions of 60 and 40 acres respectively. The former has been held in reserve for future extensions, workmen's dwellings, &c.; the latter, which lies between the canal and the embankment of the London and North-Western Railway, is shown on the plan given on p. 269, and is the scene of the company's present operations.

A private dock is being constructed in connection with the canal, and a siding from the railway will be laid down when circumstances render it desirable.

Besides affording these facilities for the transport of raw materials and finished products, and for the supply of coal and water, the site is quite level, and possesses the advantage of an excellent sub-soil of sand and gravel.

The buildings already erected comprise the main engineering works and offices, power station and testing department, foundry, conduit factory and carbon works, in addition to men's mess-room, club-house, cottages for some of the workpeople, &c.

The erection of the buildings was begun in October, 1900, and the engineering works were set in operation about six months ago. The carbon works commenced work a few months later, and the conduit factory followed suit on January 1st of this year. It will be seen, on reference to the plan, that the respective buildings are spaced at considerable distances apart, so as to provide for extensions and for the erection of other factories in the future.

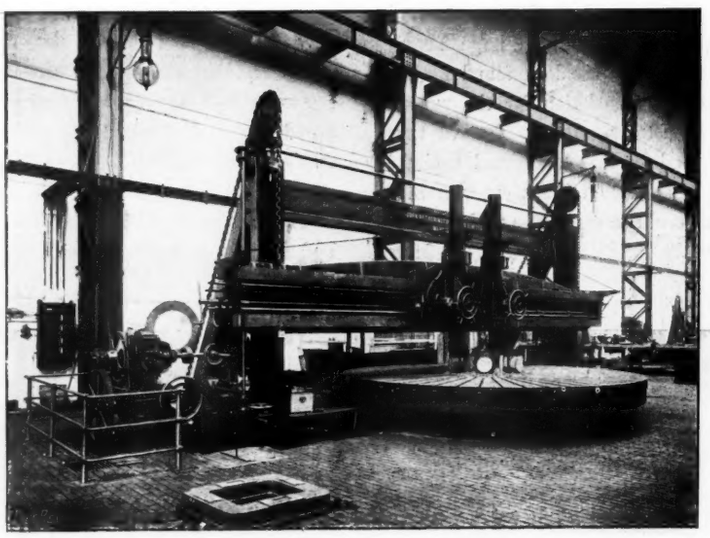


POWER STATION: GENERATING PLANT IN ENGINE ROOM.

Power Station.—In designing the plant for the supply of light and power to the various departments, it was decided to adopt direct current rather than a polyphase system, as the area to be served was of small extent, and there was no special advantage to be derived from the use of the latter. The great majority of the motors manufactured are of the direct current type, and this consideration had much weight in the choice of the system of supply. In order to serve all purposes to the best advantage, the natural course, which was adopted, was that of laying down an installation on the three-wire system, after the manner of a central station, thus

reproducing in the works the conditions under which the manufactured products would be utilised. Power for testing alternating current motors is provided by means of a motor-generator.

The generating plant at present installed consists of a 350-KW. dynamo coupled direct to a Galloway high-speed engine, a 250-KW. dynamo driven by a Davey, Paxman "Peache" engine, and a 50-KW. dynamo coupled to a Belliss engine. The two large sets are shown in our view on p. 267. The engines are supplied with steam by three Galloway boilers, each capable of evaporating 6,700 lbs. of water per hour; superheaters are fixed in the down-take at the back of the boilers, and a Green economiser has been provided. A Wheeler condensing set has also been installed.

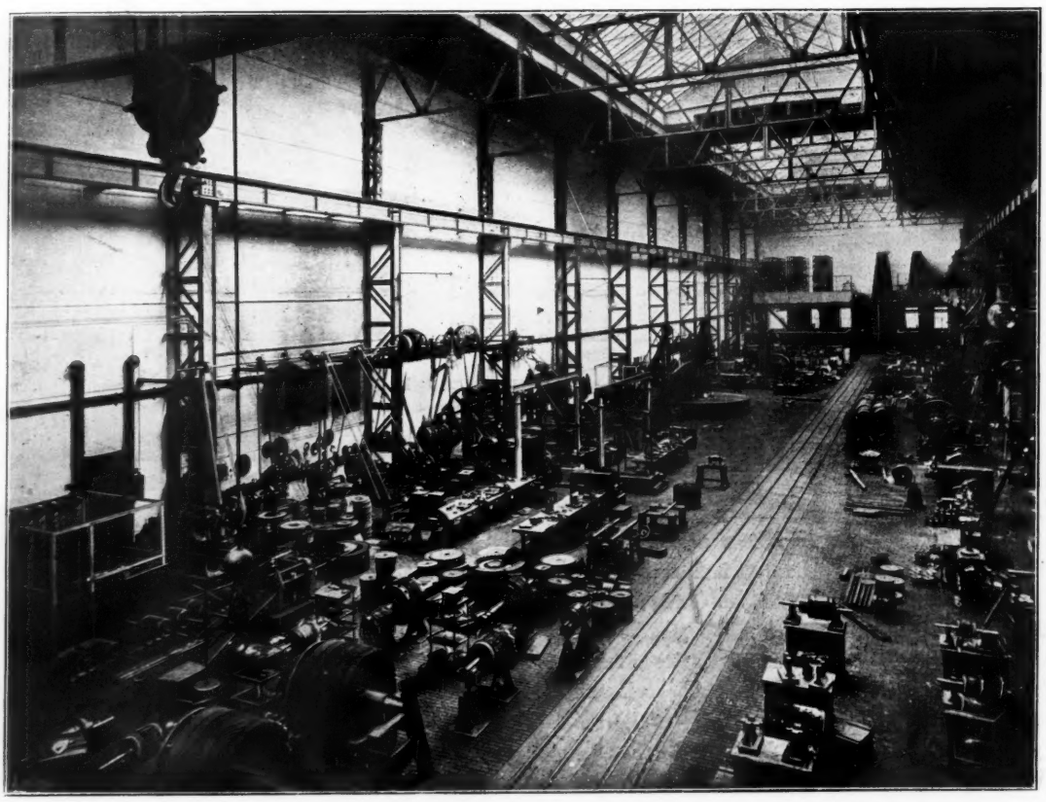


24-FT. BORING MILL.

As will be seen on reference to the plan on p. 269, the power station has been built close by the canal, so as to provide facilities for the supply of coal and water, and ample space is available for extensions to meet the future requirements of the works. Adjoining the power station the test room and packing shop are appropriately located.

Power is transmitted from the generating station to the various departments by means of overhead lines, supported by insulators on poles, or on brackets fixed to the buildings.

Engineering Works.—The most important of the manufacturing departments are the engineering works, which are situated approximately at the centre of the site, and are devoted almost entirely to the construction of dynamos and motors. The buildings consist of two bays, each 340 ft. long, 60 ft. wide and 55 ft. high; at the south end of the east bay there is a block of offices, including accommodation for the commercial and technical staffs, drawing offices, &c. The respective bays are shown in the accompanying illustrations, from which it will be seen that they are extremely well-lighted, and are provided with white glazed brick walls; they are also heated and ventilated with hot air ducts under the floor. A double line of standard gauge railway runs from end to end of each bay, and communicates with the railway in the yard outside.



ENGINEERING WORKS: WEST BAY, FROM SOUTH.

At the south end of the west bay a gallery is provided, for the production of former-wound armature coils. As will be

seen from our illustration, the coils are mechanically wound by girls, and are afterwards taped by special machines. Before being taped, the coils are subjected to the usual dipping process, and they are also impregnated with varnish after the taping has been completed.

Winding Armature Coils on Formers.

Above this gallery, and running across both bays, is another gallery, devoted to small brass work, while on the ground floor at this end of the bay, armature winding is carried on.

At the north end of the building are located the stores, consisting of a ground floor and upper floor, which are used for the storage of raw materials and of the finished component parts of motors.

Generally speaking, the greater portion of the material is naturally received at the stores end, and consequently at this point marking tables are provided for the preliminary processes.

Except in the case of the largest tools, which are independently driven by electric motors, the machine tools are driven from main shafting. This shafting is about 300 ft. in length; it is supported by the centre line of stanchions, and is divided into three sections, each driven by its own motor, as shown in our illustration of the east bay on p. 270.

To facilitate the orderly forward progress of the mechanical parts under construction, the machine tools are grouped as follows:—

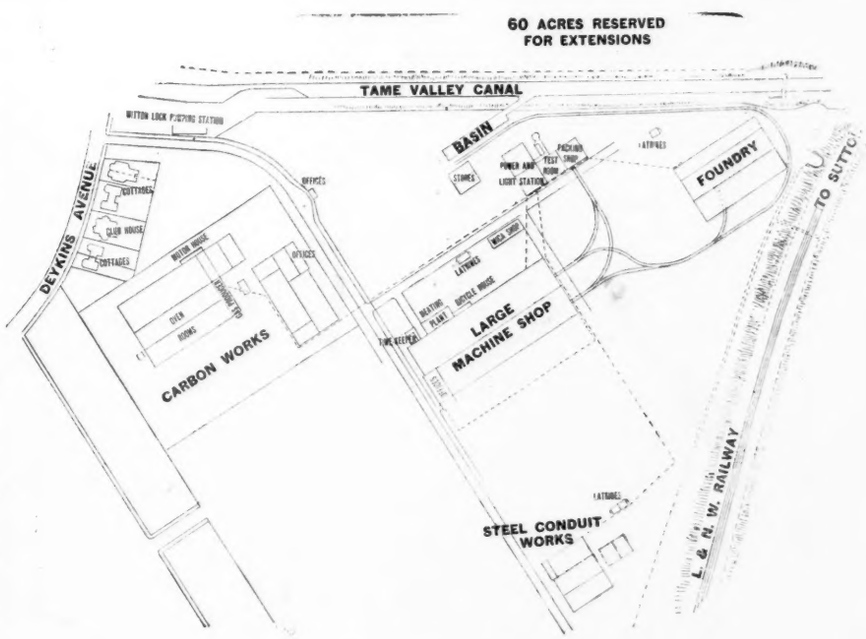
Group	No. 1	Milling machines.
,,	2	Planers and shapers.
,,	3	Boring machines.
,,	4	Boring mills.
,,	5	Lathes.
,,	6	Drilling machines.

This not only enables the work to go through the shops in an expeditious manner, but also allows of the economical and efficient supervision of each group of machine tools and of the work turned out from them by a foreman who is a specialist in that particular class of work. Each foreman of a group of machine tools is provided with a small office enclosure, in which are racks for the convenient storage of special loose tools and jigs appertaining to the particular type of machines which he supervises; the racks are hung on hinges in such a way that while they occupy the minimum of space, ready access can be obtained to any one of them without loss of time. The enclosure further answers the purpose of storage of time cards and of the drawings relating to the work in hand. One of these enclosures is well shown in our view of the west bay.

While the special machine tools are thus provided for, there is a separate tool-making department at the north end of the west bay; alongside this is the tool room stores, which again adjoins the general material stores.

The east bay is at present taken up with machines of the smaller sizes; in the west bay there are machine tools capable of dealing with the heaviest class of electrical machinery. One of our illustrations on p. 268 shows a large boring mill built by Messrs. Hetherington & Sons, capable of taking in a magnet wheel or armature frame over 24 ft. in diameter. This machine tool is driven by a 15-H.P. motor.

After large work has been operated upon either in turning or boring, it proceeds to the large surface bed shown in another view, where it is again dealt with by the various portable tools illustrated. This bed is 75 ft. long × 21 ft. wide, and is at present equipped with two upright side planing machines, one 60 in. slotter and one Universal drilling machine, all of which were made by Messrs. Kendall and Gent; there is also one combined drilling and boring machine, made by Newton, of Philadelphia. Each machine tool is, of course, portable and self-contained with its own electric motor.



Witton Works: Plan of Site.

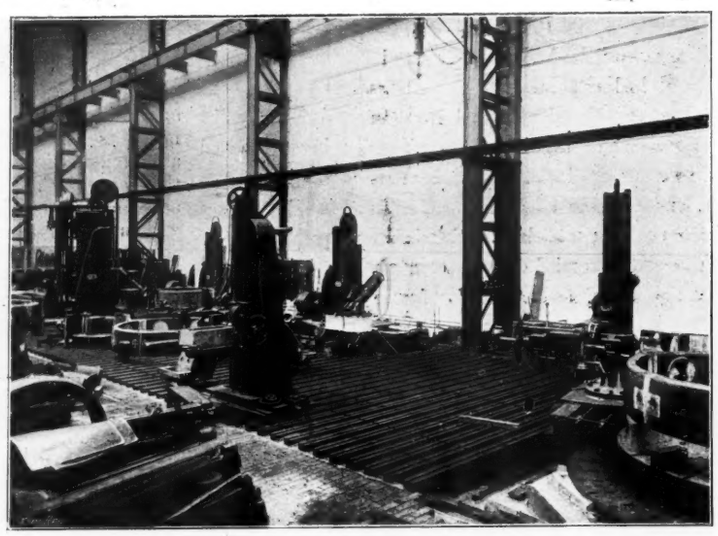
On the western side of the west bay is the stamping

department, where the core plates are produced and assembled on their respective shafts.

The commutators are built in the opposite bay, great care being taken in their construction. The commutators are in all cases subjected to hydraulic pressure, and are thoroughly well dried before being mounted on the armature shafts.

On the plan are shown the extensions which are contemplated in the near future; in order to carry these out with the minimum of interference with the work in progress and in the most economical manner, the steel stanchions are of sufficient strength to take the new bays when required. The demolition of the light walls filling in the spaces between the stanchions is practically the only loss incurred.

In the west bay is provided a three-motor crane capable of lifting up to 30 tons, with an auxiliary quick lift for lighter loads.



Large Surface Bed, with Portable Tools.

The east bay is traversed by a 15-ton three-motor crane, with a similar attachment for dealing with light loads.

As soon as the machines have been completed and assembled, they are conveyed to the test room by means of the standard gauge railway which connects the principal departments.

Test Room.—A 5-ton crane is provided in the test room for the convenient handling of machinery under test, and there are two large pits in the floor of the room—one for testing large alternators, and the second for dealing with direct current machines of large sizes. The dimensions of the pits are capable of adjustment by means of cross girders to suit the various widths and diameters of machines undergoing test.

The room is provided with a main switchboard, with a full complement of instruments for the measurement of power, both electrical and mechanical.

The machines having passed through the various tests, they are sent to the adjacent painting and packing room which, as already mentioned, is situated alongside the test room. This arrangement enables the machines to be expeditiously packed and despatched as soon as the tests are completed.

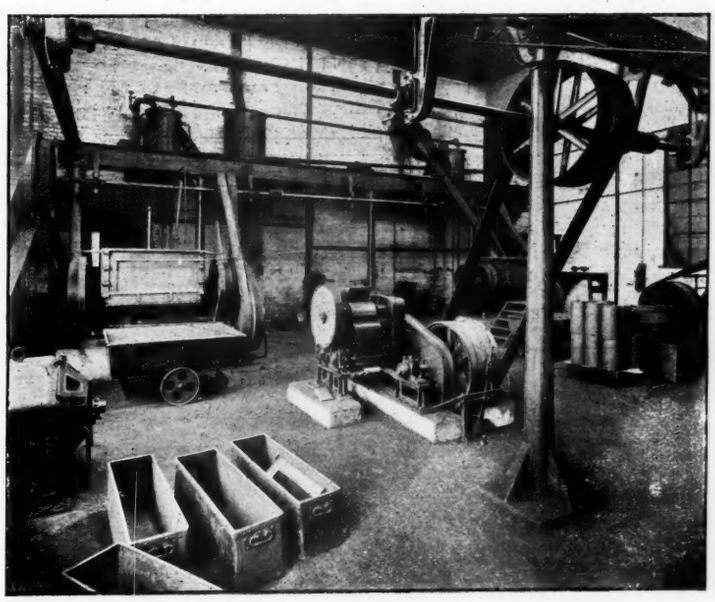
Engineering Works: East Bay, from North.

Foundry.—One of our illustrations shows the interior of the foundry, which is 200 ft. long and 50 ft. wide, and is located near the canal. It is at present fitted with one cupola, but an extension to the foundry is already in hand,

and a second cupola will be erected within the next few months. The height from the floor to the crane rail is 25 ft., and a three-motor crane has been installed capable of lifting up to 5 tons weight. The smithy is arranged alongside the foundry, and is fitted with down-draught hearths.

The temporary pattern shop is also adjacent to the foundry, and, of course, the various subsidiary machinery here is run by means of electric power, as in the case of all the other buildings.

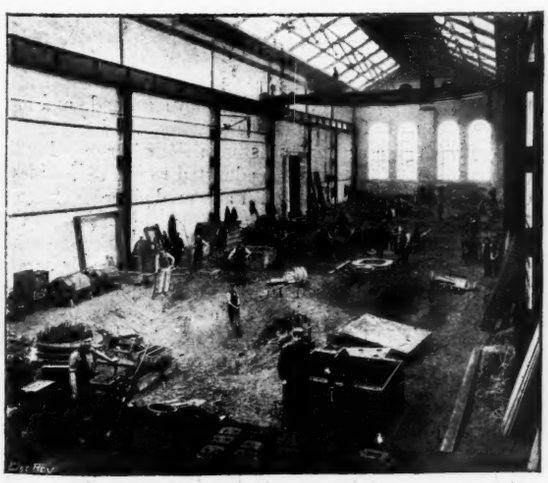
No manufacturing works can now be considered up-to-date without a good system of prime costing, and we are pleased to note that in these works a complete example of the application of the card system is in use. The attendance of the workmen is recorded by means of Rochester clocks, which print each man's time of entry and departure, day by day, upon a card. Every time a new job is given to a man he is provided with a card showing the operation to be done, and marked with the time of starting. When the job is finished the card is given up, marked by the foreman with the time of completion. The several cards used for any one man in a day are kept together, and on the following morning are compared with his clock record, thus ensuring that all time paid for according to the clock register is accounted for in the record of time upon the various jobs. To enable this detailed costing to be carried out, the orders are thoroughly sub-divided into their various components before they reach the shop superintendent, who is thus able to distribute them to his various shop foremen as required, and at the same time to keep for himself a card record of the position of every piece of work for which he is given instructions.



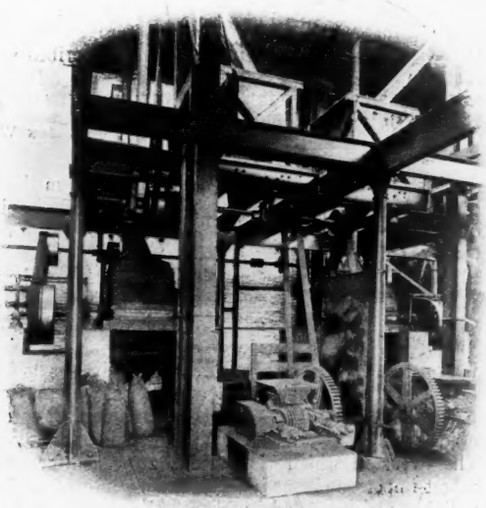
Carbon Works: Mixing Machines.

The well-being of the men is amply provided for, in the way of mess-rooms, lavatories, &c., and it is the intention of the company to erect a large number of cottages for them upon its property in the vicinity of the works. Judging from the appearance and bearing of the employés on the occasion of a recent visit to the works, we are satisfied that the result has already been to attract a superior class of workmen, capable of appreciating the cleanliness and comfort of their surroundings, and that the company will be fully recompensed for its attention to these important details.

Conduit Works.—The General Electric Co., Ltd., has carried on the manufacture of steel conduits and fittings for electric wiring for some years, having early recognised the importance of this branch of the industry. Finding its existing works unable to cope with the increasing demand, the company decided to take advantage of the opportunity to erect a new factory on its Witton estate, and to equip it with the latest machinery for the manufacture of these materials. The building was begun about 18 months ago, and manufacturing was commenced with the current year. The buildings are situated on the east corner of the site, as shown in the plan, and consist of three main bays, with offices, packing-room and enamelling shop in the rear. In these works the manufacture of enamelled steel conduits and fittings on the "Union" system is carried on.



View in the Foundry.



Carbon Works: Grinding Machines.

One bay is equipped with machines for drilling, screwing, tapping, grinding and fitting-up the many details that go to make up a complete conduit system, such as junction and switch boxes, tees, bends, &c. Another bay is laid out for

the manufacture of close-joint brazed and screwed conduit with specially-constructed machinery, while the third bay is utilised for storage. The stores are fitted up for the reception of rough materials on one side and finished goods on the other, and all three bays are provided with inter-connecting tramlines. Needless to say, all the machinery is driven by electric power, with the G.E. Co., Ltd.'s motors, and all the wiring of the various departments of the Witton works has been carried out with "Union" conduits and fittings.

Every care has been taken to arrange the works so as to turn out the manufactured products with the maximum of efficiency and economy.

Carbon Works.—Without doubt the most interesting department of the works is that which is devoted to the manufacture of carbon rods and plates for arc lamps, batteries, electrolytic furnaces, &c. This industry has been for many years lost to this country, practically the whole of the carbons used here having been imported from the Continent, and we sincerely hope that the company's plucky attempt to regain a share of the business will receive the support which it deserves.

The buildings are located on the opposite side of the main road to the rest of the works, as shown in the plan, and cover a considerable area; the works have been laid out in accordance with the most up-to-date Continental practice, and the latest and best machinery obtainable has been installed, under the supervision of experts, with a view to securing the highest quality in the manufactured products combined with the lowest cost of production.

The ovens in which the carbons are baked form one of the most important items in the manufacture of high-class arc light carbons, and without the latest and most economical type it would be an utter impossibility to produce good carbons at the prices which at present very keen competition requires. Needless to say, the ovens are of the most improved continuous baking type; they cover an enormous area, as will be gathered from the fact that when all are full they contain upwards of 200 tons of manufactured material.

The factory consists of two main buildings, which, together with the outhouses, yard, &c., cover an area of about four acres. The first of these buildings contains on the north side machinery for crushing, grinding, mixing, stamping and pressing raw material, carefully arranged according to the different stages of manufacture. One of our illustrations on p. 271 shows some of the mixing machines, while another is a view of the grinding machinery. A third, on p. 273, shows one of the hydraulic presses used for the squirting or extrusion of carbon rods and plates. On the south side of the same building are arranged the extensive continuous-baking ovens, referred to above.

The material enters at one end of the building and passes through continuously in one direction from stage to stage, thus reducing the amount of handling and labour, which is a very large item, as much as possible.

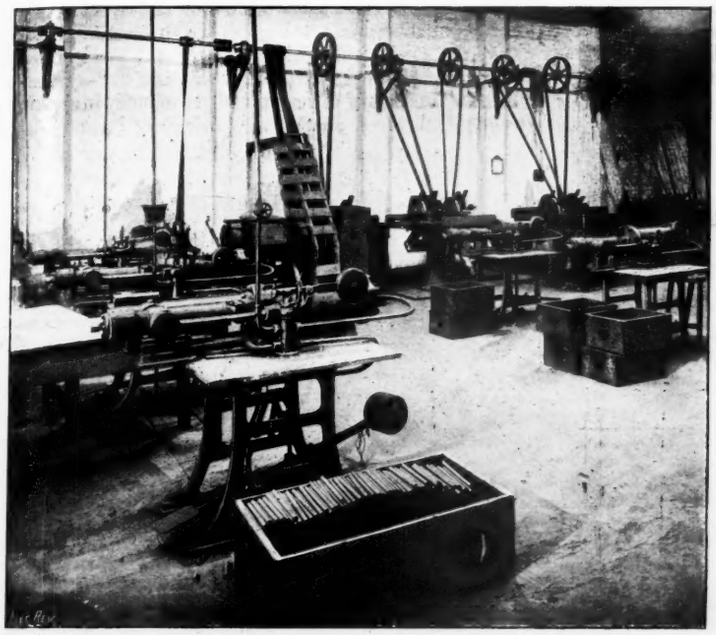
The ovens are heated by producer gas, which passes from the generators through a duct running down the centre between two rows of ovens, beneath the floor level, as shown in the accompanying illustration; a second set of ovens, for the preliminary baking, is built above ground, and forms the background of the same view.

Carbon Works: Range of Ovens.

By means of an ingenious system of water-sealed outlets and movable pipes the gas is admitted to one of a series of ovens, in which it is burnt with air, producing an extremely high temperature, and the hot products of combustion are led away through the succeeding ovens until they are carried off to the chimney, at a comparatively low temperature, by the movable flue shown in the foreground of the view given above. Thus the whole of the available heat of the gas is utilised. While a range of ovens is being heated in this way, others in advance of the range are being recharged, and those in the rear of it are cooling down. From time to time fresh ovens are brought into the range at the cool end, and others are cut off at the hot end, the process being carried on without cessation in an endless cycle. The pots in which the carbons are baked are made on the premises; the illustration shows these, and the method of handling them.

From the oven-house the carbons, when baked, are transferred, by means of a specially designed mono-rail traveller with suitable trucks, to the second main building, which contains the machinery for cutting, sorting, coring and finishing. This building also contains the stores, which are

divided into two portions, namely, the packing and despatch departments, and the chemical laboratory, test rooms and general offices. In the main store the baked carbons, as they come from the ovens in long rods, are stored ready for cutting



Presses for Coring Carbons.

up into different lengths as required; by this means it is possible to promptly execute almost any order, for odd as well as for standard lengths and sizes, at the shortest notice. The second or "finished" stores are intended for stocking the standard sizes and lengths always in demand. The laboratory is equipped with all the necessary appliances and scientific apparatus, and in the test room provision is made for testing carbons in all the usual and well-known types of arc lamps.

Several qualities of carbons are made at Witton Works. The first is the well-known "Apostle" carbon, which is manufactured in large quantities; this is the commercial carbon which competes with all of the best-known makes from the Continent.

For special purposes a very superior carbon, known as "Imperial Crown," is made; this has a little less ash residue, and is superior in appearance and finish to the Apostle brand.

The third or best quality is the "Witton" carbon, made principally for enclosed arc lamps; this quality is produced from the finest material procurable, and the greatest care is taken in its manufacture to turn the carbons out perfectly true to gauge and absolutely straight. Owing to the use of the very best material, it leaves a minimum of ash or discolouring matter on the globes of the lamps, and burns with a perfectly steady white light.

Carbons of the same quality are also made for open-type lamps to order when required; in addition to burning practically without ash, it is claimed tha with these carbons three lamps can be burned in series on 100 volts direct current, instead of only two as heretofore, an advantage which it is impossible to obtain from any other make of carbon.

In addition to the plant for arc lamp carbons, special machinery has been put down for turning out carbon battery plates and manganese agglomerate blocks in large quantities. Carbon brushes for motors and generators, and electrodes for electro-chemical manufacturers, &c., are included amongst the many articles which can be turned out at these works.

At present the machinery is capable of producing, apart from battery plates, blocks, &c., over 13,000,000 ft. of electric light carbons per year, whilst provision has been made for putting down machinery for three times this output.

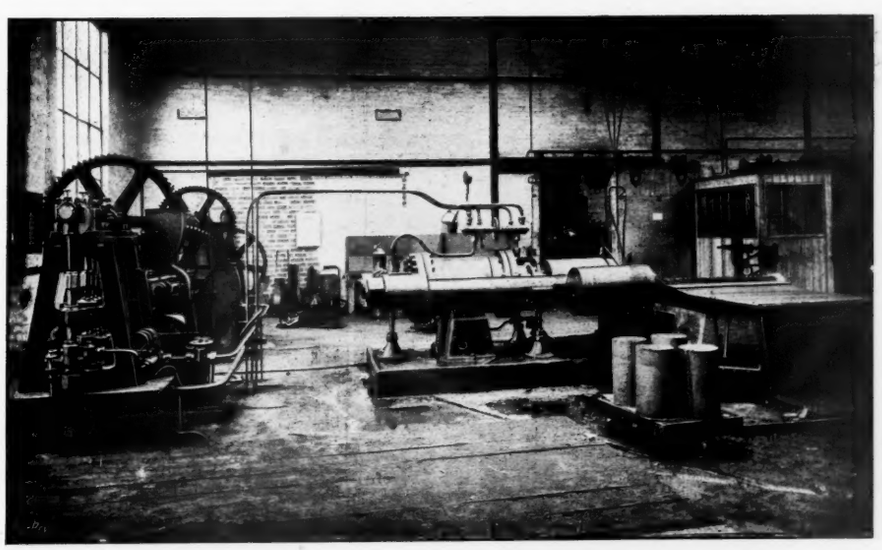
The whole of the factory is driven by G.E.C. electric motors of the enclosed type, upwards of 250 H.P. being installed.

The factory is lighted by means of arc lamps of the Angold pattern, also of G.E.C. manufacture, both open and enclosed type being used, connected in series on the power circuit of 460 volts.

To facilitate the easy and rapid handling of the materials, overhead travelling cranes are provided in the shops where required, and the works are served by a railway track connecting with the system of lines laid over the whole estate.

At present the number of workpeople engaged in the works is upwards of 220, all of whom have had to be specially trained and instructed, a long and tedious operation. The industry of carbon making being absolutely a new one in this country, no experienced labour was available; but having overcome all initial difficulties in this connection, the works are now turning out carbons of unquestionable quality.

From the foregoing particulars it will be seen that the new Witton Works of the General Electric Co., Ltd., are destined to prove an important factor in British electrical engineering; moreover, the present establishment represents only the first instalment. It is intended to remove the electric light fittings factory from Sherlock Street, Birmingham, to Witton, but the Peel Works at Salford, and the other establishments belonging to or associated with the company



One of the Large Hydraulic Presses and Pumps, for Arc Lamp Carbons.

will still be carried on separately. At present the engineering shops at Witton provide accommodation for upwards of 1,000 employés; the conduit works, 200; the carbon works 220, and the Sherlock Street factory 500 workpeople; the Peel works now employ nearly 2,000 persons. The prospects before the undertaking are therefore highly favourable, and we trust that the inauguration of the new works will give a fresh impetus to the already well-established prosperity of the concern. In conclusion, we tender our thanks to the officials of the company for their kind assistance in the preparation of this article.

AUTOMOBILES AT THE CRYSTAL PALACE.

(*Continued from page* 216.)

Among the many features of interest in a show which is well filled with interesting motor-vehicles of all classes, sizes, prices and speeds, undoubtedly a special feature is the comparatively large number of electrical exhibits. We say

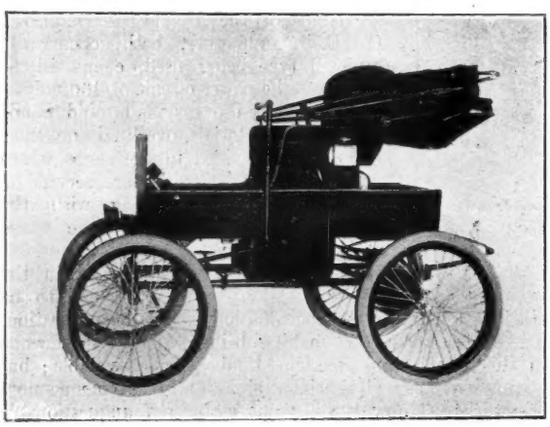


Fig. 1.

comparatively large, for, notwithstanding their known disadvantage in the excessive weight of the accumulators, they present the neatest and simplest vehicle in the show.

The average purchaser, though not an engineer, is probably outwardly familiar with a steam engine and boiler, but his feelings may be better imagined than described when confronted with a harmless-looking carriage, whose internal arrangements may not inaptly be compared with those of

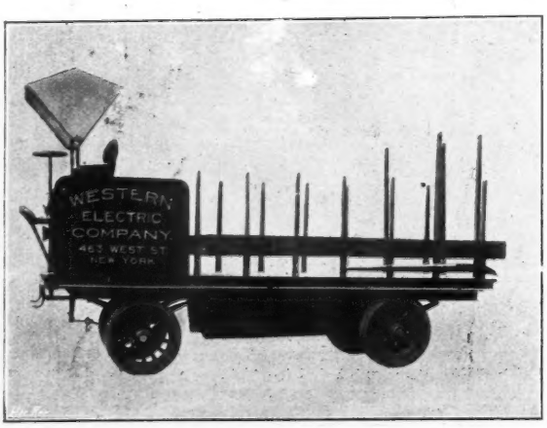


Fig. 2.

a battleship, including four-cylinder engines, reservoirs, water-jackets, valves and pipes *ad libitum*, not to mention his subsequent impressions from vibration. After this the electrical vehicle, even in its present form, comes as a relief, and with the great development which is everywhere apparent in electric supply by power companies, municipalities and local authorities in general; facilities for recharging accumulators will soon be multiplied, and their sphere of action greatly enlarged.

The electrical cars at the show are largely of American origin; but there are some English and German exhibits. In design three principal types are shown—(1) with the battery under and behind the seat; (2) with the battery under a "bonnet" in front of the car, giving a similarity in appearance to the petrol vehicle; (3) with the battery hung under the

Fig. 3.

frame of the car, in a case which is detachable. It is claimed for the latter type that all damage to the carriage is obviated when the battery has to be removed for any purpose.

The controlling and steering arrangements are exceedingly simple, being, as a rule, contained in two handles, and the motors and, in the case of rigid drives, all the gearing is dust and water-proof encased.

Our attention was particularly drawn to the exhibits of the Anglo-American Motor Car Co., who show a variety of electrically-driven vehicles constructed by the Baker Motor Vehicle Co., of Cleveland, Ohio, combining lightness, strength and easy running qualities, with the additional advantage of a most cleanly and compact motive power.

They are fitted with sufficient battery power to travel 40 miles on a level and good road (not being designed for long-

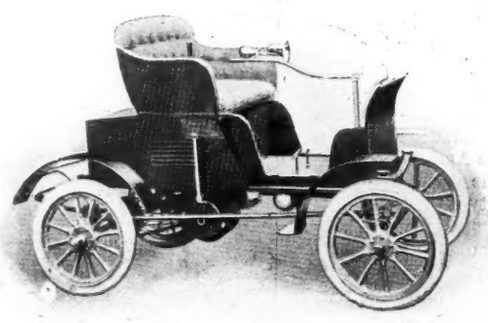


Fig. 4.

distance travelling), also with the Baker motor, a specially constructed multipolar machine with ball bearings. The motor drives on to the rear axle through a chain.

A controlling lever is located on the left hand of the seat, there being three forward speeds and a reverse. A separate handle is provided for steering, and of the two brakes which are fitted, the motor brake can be applied through the controller handle and the emergency brake by means of foot pressure, which operates a friction gear on the rear axle.

The carriage is fully equipped with electric lamps, Weston volt-ammeter, mileage indicators, &c.

Fig. 1 illustrates the Baker Imperial, and fig. 2 a trolley wagon fitted with an electric winch for cable carrying.

Another very handy type of automobile is the "Crowdus Electric Runabout," fig. 3, of which two sizes were shown by Mr. W. A. Crowdus, capable of travelling distances of 50 and 100 miles respectively with one charge.

These cars are exceedingly neat and compact in appearance, and the component parts are few and simple, in striking contrast to the majority of the cars on neighbouring stands which are driven by petrol.

The body of the car, which contains the battery enclosed under and behind the seat, is mounted on a light but strong underframe, on to which is fitted the motor and driving gear (all of which is encased). The car has an exceedingly flexible under-gear, enabling the wheels to adapt themselves to any inequality of the road, and is fitted with a single controlling lever, having a spadehandle, which may be turned into five positions, varying the speed of the car from three to 20 miles per hour, and the same number for travelling in a reverse direction.

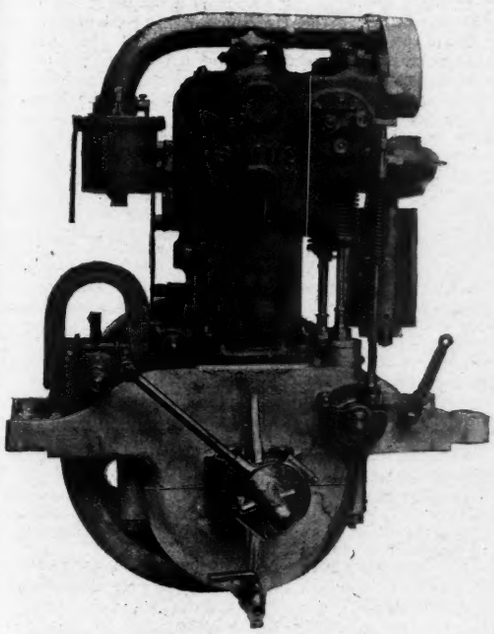


Fig. 5.

This controlling lever has a special position for charging the battery, and can also be used for electrically braking the vehicle, for which purpose the motor is utilised as a dynamo and re-charges the cells, a very useful feature in a hilly country. A powerful foot-brake is also fitted, operating on the back wheels, and the machine is equipped with electric headlights, meters, and other accessories.

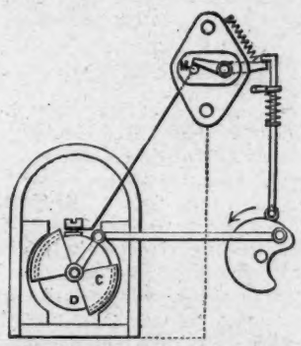
A two-passenger vehicle of a similar appearance to the above, but heavier, is shown by the London Electric Mobile Syndicate, Ltd., and illustrated in fig. 4. It has a range of 40 miles on one charge, and the speed may be varied between three and 12 miles per hour. There is a 40-cell battery; the controller is situated at the side, and is provided with reverse and brake positions (running the motor—a four-polar—as a dynamo).

The Electromobile Co. showed their 1903 type of carriage, the main features of which are the straight chassis, or underframe (which is common to several types of their vehicles), and the underslung, interchangeable battery.

The chassis and battery box together weigh 9 cwts., and for recharging, the battery box is lowered from under the vehicle, and conveyed to any convenient position for that purpose. The battery consists of 42 "Contal" cells of a special pasted type, and weighs about 8 cwt. Its capacity is 135 ampere-hours, and it affords sufficient energy to propel these vehicles upwards of 50 miles over average roads. The battery weight is about 33 per cent. of the total weight of the carriage.

Each plate is formed of two thin grids of antimoniated lead riveted together, and presenting 32 square holes for the active material, which is compressed into the grids by means of an hydraulic press; the latter rivets the plates and perforates each pellet of active material with nine holes. Experience has shown their durability to be commercially satisfactory, the positive plates having a life of from 12 to 18 months, according to the work done. The plates of the battery are of small cost, and very easily replaced.

The motor gives 5 B H.P. on a continuous load, but it can safely exert over 10 H P. for shorter periods. Its normal speed is about 1,500 revs. per minute. It is a series-wound bi-polar, having two commutators connected to separate armature windings. The designers, MM. Contal and Gasnier, have introduced a very compact arrangement of field castings and bobbins, by which magnetic joints are avoided, and the distortion of field due to armature reaction



C, Oscillating shield; D, Stationary armature; M, Ignition plug. Dotted line represents return circuit through frame of vehicle.

Fig. 6.

is counteracted, resulting in a reduction of field ampere-turns and a total suppression of sparking. The weight of the motor is 162 lbs.

The motor drives through a double train of double helical gearing to the differential, and thence to the hub of the rear wheels by shafts which rotate in a practically stationary hollow axle—built up of two tubes united by a cast-steel gear box, and extending within the road-wheel hubs, which revolve upon them. By this means the internal driving shafts are relieved of all bending stress and are in simple torsion. The motor and driving mechanism are entirely encased, and the gear runs in oil.

The controller is arranged to give five forward speeds ranging from 3 to 15 miles per hour, one reverse speed, and to operate two electrical brakes, forming an exceedingly compact mechanism.

The vehicle is also fitted with an efficient steering gear and foot brake, operating on the hubs of the rear wheels. The operation of applying the foot brake automatically opens the circuit, allowing the carriage to run free and the brake to exercise full control. The approximate weights of the several types of vehicle exhibited by this company, and including battery and equipment, are as follows:—Victoria, 22 cwt.; brougham, 22½ cwt.; single landaulet, 23 cwt.; double landaulet, 23½ cwt.

The City and Suburban Carriage Co., of "Niagara," York Street, Westminster, S.W., is introducing a novelty in the form of a combined petrol-electrical vehicle, which, it is considered, will gain the approval and support of a section of people who, while objecting to the vibration and other discomforts of petrol cars pure and simple, have a desire to run greater distances than the ordinary electric carriage is built to accomplish, without regard to the proximity of a charging station.

The carriage shown at the Palace did not represent a final type—those now building have a 9 H.P. engine in place of the 5 H.P. one shown. We shall at a later date illustrate and describe this type in conjunction with the remaining electrically-propelled vehicles which were exhibited by (1) Messrs. Pritchetts & Gold, Ltd., Feltham, Middlesex; (2) the Automobile Supply Co., Ltd. (who were showing a "Scheele" electric carriage); (3) Messrs. E. W. Hart, who exhibited an electric landaulet.

The Brush Electrical Engineering Co. had a large exhibit, but solely of the petrol type of vehicle. We understand, however, that this firm intends in the near future to justify its title, and that developments in the way of electrically-propelled vehicles may be expected.

Turning to the exhibits of accessories, the fine display of magneto machines for ignition purposes, on the well-known Simms-Bosch principle, by the Simms Manufacturing Co., Ltd., certainly occupied a prominent position. This firm makes a speciality of magnetos of the oscillating sleeve, rotary armature, and rotary-sleeve types, and we append a short description and illustrations of the construction and application of the oscillating type for the ignition on a small petrol motor. The arrangement consists of several permanent horse-shoe magnets fixed side by side and mounted on an aluminium or gun-metal base. Pole-pieces are fixed between the extremities, bored out to accommodate an H-type armature and oscillating shield. The armature is immovable, one end of its coils being fixed to the base, and the other led to the sparking plug on the engine.

The sparks are produced by giving an oscillatory motion to the soft iron shield, which partially envelopes the armature, and by virtue of its movement, allows of the alternate formation and destruction of a field through the armature, giving rise to momentarily induced currents, which expend their energy in this form.

It will be noted in fig. 6 that the oscillating shield is linked to a cam, or eccentric-driven by the engine; the arrangement by which, through the motion of the cam, the small lever in the cylinder head makes and breaks contact with the sparking plug, will be easily understood from the diagram. It may be mentioned that the mechanism breaks contact when the shield is central, and the field through the armature most fully intercepted.

We illustrate an 8—10-B.H.P. twin-cylinder motor (fig. 5), in which the magneto is operated by an eccentric from the main shaft, and the cam on the second motion shaft and the vertical rod and lever for operating the contact in the cylinder head are clearly shown.

Among those who showed accumulators—and they were not a few—were Messrs. Van Raden & Co., who make a speciality of woven-glass accumulators, in which the carrier of the active material is not made entirely of lead, but is formed of a grid in which lead wires are interwoven as a warp thread and fine elastic glass wool as a weft.

The active material is compressed into this woven fabric and held so rigidly as to effectively withstand the disintegrating effect of continued vibration; also these plates do not buckle. In assembling the accumulator the electrodes are enveloped in sheets of woven glass, which it is claimed act as a cushion between the plates and occupy a minimum space, are exceedingly porous, and give perfect insulation. These accumulators are exceedingly light compared with their capacity, and have practically no self-discharge.

(*To be continued.*)

NOTES.

(*Continued from page 266.*)

Cheap Work This!—A correspondent has sent on to us a copy of a circular which is being sent out by a firm of electrical installation contractors up-country giving prices at which wiring work is undertaken. One of the statements appearing in the list is to the effect that "the whole installation, including lamp, wiring, fittings, switches, &c., can be carried out at 5s. per lamp for shop lighting." This is interesting in connection with the correspondence which is now proceeding in our other columns on the wiring question. How does this particular contractor like the idea of rigorous inspection of buildings? We need hardly conjecture as to the quality of the material and workmanship on a job carried out at such a figure as this.

South African Trade.—An interesting paper on the "Trade and Industry of South Africa" was delivered before the Royal Colonial Institute on Tuesday evening by Mr. Ben. H. Morgan. Mr. Morgan recently went out to South Africa as one of the Commissioners of the National Industrial Association, and his excellent report on the position of the engineering trades out there was referred to in our issue of November 14th last.

Scholarships.—We have received from the clerk to the Technical Instruction Department at Wakefield, a pamphet giving particulars of a scheme for scholarships, free studentships and exhibitions which is being introduced for the school-year 1903—1904. Four technological scholarships, each valued £60, are to be offered shortly to young artizans who already have had certain mill or workshop experience.

Appointments Vacant.—Charge engineers for Newport; car shed foreman, chief inspector, and others for Ilford tramways; a canvasser for Hackney; distribution engineer at Willesden at £140. See "Official Notices" to-day.

Rosling & Fynn.—The Phœnix Dynamo Co., of Bradford, have entered into arrangements with the liquidators of Messrs. Rosling & Fynn, Ltd. (Mr. W. M.Gray), for the purchase by them of the works of the latter-named company at Thornbury, Bradford.

For Sale.—A 300-KW. steam alternator (B.T.H. three-phase 2,500 volts) by the Dublin United Tramways Co. See advertisement pages to-day.

Personal.—In a note on "Pipe-Covering Tests" appearing on p. 244 of our last issue, we misspelt the name of the writer of the American contribution. It should have been given as Mr. H. G. Stott, not Statt. Mr. Stott is a native of the Orkney Islands, who settled in the U.S. some years ago, becoming chief electrician of the Buffalo General Electric Co. A year or two ago he was appointed as superintendent of power for the Manhattan Elevated Railway, of New York, during the conversion from steam to electricity, and he now has supreme control of the Manhattan East River power house. Mr. Stott may, therefore, be claimed as one more instance of the British engineer who has achieved considerable success in the States.

The manager of the Liverpool electric tramway system (Mr. C. R. Bellamy) has been invited to the national convention on municipal ownership of public franchises which commences in New York on February 25th. The Corporation Tramways Committee has unanimously granted Mr. Bellamy permission to accept the invitation.

Warrington T.C. has granted the following increases of salary:—Mr. W. H. Grimsdale, electrical and tramways manager, from £350 to £400 per annum; Mr. F. V. L. Mathias, chief assistant electrical engineer and tramways manager, from £180 to £200.

The Gloucester Corporation tramways staff on February 5th presented a case of silver mounted pipes, tobacco jar, and ash tray to the manager (Mr. E. Stephens), as a token of esteem.

The Salford T.C. on February 5th increased the salary of Mr. E. Hatton, general manager of the tramways, from £400 to £500.

Mr. R. Knight, of the British Thomson-Houston Co., who has been on a short business visit to the U.S.A., left New York for England on January 28th on the ss. *Celtic*.

Mr. Thomas Henry Parrott, M.I.M.E., who has been connected with the business of Belliss & Morcom, Ltd., for upwards of 20 years has been elected to a seat on the board of the company. He will in future act as general manager and director.

Mr. Heyl-Dia has resigned the managing directorship of the St. Helens Cable Co., and will take up work as a consulting electrical and chemical engineer in connection with cable work.

Telegraph Training College.—The first annual dinner in connection with the South London Telegraph Training College was held at the Atlantic Hotel, Brixton, on 4th inst., when about 50 members of the staff and their friends sat down under the chairmanship of the principal, Mr. Chas. B. Ward. During the past year over 500 men were trained at the College and sent out to the Colonial telegraphs, 14 to the cable companies, 10 to the Colonial railway telegraphs, 12 to private and newspaper wires, and over 100 for the sub-postal telegraph service.

Shock Fatality.—At Middlesbrough on 5th inst. an inquest was held concerning the death of James MacNamara, a workman at the North Eston Steel Works, Middlesbrough, as the result of electrocution. It was suggested that at all works where there was electrical power, workmen should be protected by having the switches enclosed in boxes, and only the handle for turning the current on and off, exposed.

THE CENTRAL STATION ENGINEER.

The Bournemouth Corporation has appointed Mr. I. Bulpin borough electrical engineer in charge of the generating stations and assistant tramways engineer at £300 per annum. The Tramways Committee wished to express its high appreciation of the services rendered by Mr. F. W. Lacey, the borough engineer, in connection with the design and supervision of the tramways undertaking, and it accordingly recommended that an allowance of £1,000 be made to him in respect thereof. When the matter came before the Council it was referred back to a Committee of the whole Council, some members holding that an increase of salary was a better form of remuneration to adopt. It was shown that, had outside professional men been engaged, the cost to the Council in commission would have been on the way to £9,000.

Mr. J. D. Waddell, recently of Harrogate and Watford, has been appointed at the Hampstead borough electricity works to fill the vacancy caused through the promotion of Mr. A. Oxley.

Mr. L. L. Hobrell, of Coventry, has been appointed shift engineer at Walsall electricity works.

The burgh electrical engineer of Ayr, Mr. A. J. Fuller, having been appointed electrical engineer to the borough of Fulham, the T.C. has appointed as his successor Mr. R. Marshall, chief assistant, at a salary of £200, to be increased to £250 in six months.

Recently the staff and employés of the Huddersfield Corporation electric supply department were entertained to tea by the Mayor, Mr. Alderman F. Calvert, chairman of the Electricity Committee, and a handsome timepiece and side ornaments were presented to Mr. J. A. Swift, the chief clerk, who was recently married.

Mr. A. S. Barnard, borough electrical engineer at Hull, has been appointed by the Colonial Office as electrical engineer for the Island of Ceylon, at a salary of £1,000 per year.

Mr. C. H. Heron, electrical engineer, of Worksop, has been appointed electrical engineer to the Elland U.D.C.

Mr. R. S. Downe, borough electrical engineer of Southport, was on February 5th married at the Chapel Royal, Savoy, London, to Miss Gertrude S. Travis, Southport. Mr. Downe was on Wednesday morning, at the close of the business of the Electricity Committee of the Southport Corporation, presented with a silver tray from the members of the Committee.

Canterbury T.C. on February 4th increased the salary of the electrical engineer (Mr. C. A. Blaschech) from £250 to £275 per annum.

The Electrical Committee of the Swansea T.C. on February 4th decided to increase the salary of Mr. Prusmann, electrical engineer, by £150 a year on condition that he remains under the Corporation for five years.

Bradford T.C. has increased the salary of Mr. William Jones, superintendent engineer of the electricity department, from £275 to £300 per year.

Middlesbrough T.C. has increased the salary of the electrical engineer, Mr. H. M. Taylor, from £250 to £300 per annum, and has also increased the salaries of some others in the department.

On Wednesday last week at a meeting of the Liverpool City Council, the recommendation of the Electric Power and Lighting Committee, respecting the appointment of Mr. Bromley Holmes as consulting engineer, and Mr. Clough as chief electrical engineer, was adopted. An amendment was moved by Mr. T. Utley that Mr. Holmes's salary be £800 and Mr. Clough's £1,000. This, however, was lost by a large majority.

ELECTRICITY SUPPLY ACCOUNTS.

Croydon Corporation Electricity Accounts.

The returns here given of the electrical undertaking of the Borough of Croydon show that substantial progress has been maintained during the year ending March 25th, 1902. Mr. T. H. Minshall was in charge of the undertaking during this period, but he has since been succeeded by Mr. J. Gray Scott.

The large increase of 735,732 in units sold is explained by the opening of the tramways (leased to the B.E.T. Co.) in the latter part of 1901.

The loans authorised for the undertaking include stock issued, £158,367; and further loans of £65,550 sanctioned, but not borrowed. It will be noted that all the items in the statement show large increases, with the exception of the average price per unit sold, which has fallen to 3·56d., and is explainable by the large percentage of energy sold for traction.

The total capacity of plant installed is 3,280 kw., and of the maximum load of 1,683 kw., lighting took 1,267 kw. and traction 416 kw.

General Statement.

Year ending March 25th—	1901.	1902.	Increase.
Total capital expenditure ...	£171,291	£212,388	£41,097
„ units sold, private ...	—	986,372	—
„ „ public ...	—	480,962	—
„ „ traction ...	—	343,053	—
„ number of units sold ...	1,074,655	1,810,387	735,732
No. of 30-watt lamps connected	—	78,386	—
Maximum load in kw. ...	922	1,683	761
Gross revenue...	£18,129	£27,483	£9,354
„ expenditure	£10,170	£14,582	£4,412
„ profit	£7,959	£12,901	£4,942
Average price per unit sold...	3·84d.	3·56d.	— ·28d.

The increase in revenue from sale of energy during the year is over £9,000, as compared with £4,500 in the previous year. The prices charged for energy are as follows:—

For lighting, 7d. and 2d. per unit (demand indicator system); power, 7d. and 1d. per unit (this has since been reduced to a fixed rate of 2½d. per unit); and for traction, 2d. per unit.

Revenue Statement.

	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Sale of energy	£17,221	3·84d.	£26,780	3·56d.	— ·28d.
Meter rents	476	·11d.	615	·08d.	— ·03d.
Sundry receipts..	432	·10d.	88	·00d.	— ·10d.
Gross revenue ...	£18,129	4·05d.	£27,483	3·64d.	— ·41d.

The works costs show a satisfactory reduction of ¼d. per unit, which is largely accounted for by the decrease of ·20d. in the item for coal. Salaries also show a decrease of ·14d. per unit, and the other items are practically stationary. The total costs now stand at under 2d. per unit, a creditable figure when the disadvantageous position of this station with regard to coal supply is considered.

Cost of Production.

	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Coal	£5,057	1·13d.	£6,954	·92d.	— ·20d.
Oil, waste, water and engine room stores.	498	·11d.	860	·11d.	·00d.
Salaries and wages incurred in generation and distribution and attending to public lamps.	1,490	·33d.	1,372	·18d.	— ·14d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and street lamps.	669	·15d.	1,838	·24d.	·09d.
Works costs ...	£7,714	1·72d.	£11,024	1·46d.	— ·25d.
Rent, rates and taxes ..	336	·07d.	416	·05d.	— ·02d.
Management expenses, salaries of managing engineer and clerical staff.	1,643	·37d.	1,968	·26d.	— ·11d.
General establishment charges, stationery and printing, law charges and insurance.	477	·11d.	1,173	·15d.	·04d.
Total costs ...	£10,170	2·27d.	£14,582	1·93d.	— ·34d.

The gross profit for the year shows a substantial increase, being £4,942 as compared with £1,242 in the previous year. Sinking fund, however, absorbs an additional £2,508.

From the balance-sheet we gather that the amount paid off loans equals £3,583, and the total sinking fund in hand is £5,081, being £458 in excess of the amount set aside for the year. This amount, together with £2,000 voted by the Council in relief of the General District Rate for year 1902-3, was taken from the sinking fund in hand of the previous year, leaving a balance of £2,380 to carry forward to a suspense account.

Profit Statement.

	1901.	1902.
Interest on loans	£5,387	£5,707
Sinking fund	2,114	4,622
Profit carried towards bad debts in next account ..	8	51
Net profit for year	450	2,520
Gross profit	£7,959	£12,901

Bristol Corporation Electricity Accounts.

The accounts for the Bristol Corporation electricity department last issued, cover the period to March 25th, 1902, and show that notwithstanding the heavy expenses on capital account connected with the New Avonbank station and the special charges for supervision, &c., of the erection of the new works, all of which are charged to revenue, Mr. Faraday Proctor has very considerably reduced the loss. The last five years have brought about marked changes in the figures:—

Year.	Revenue. Gross. £	Per unit. d.	Costs. Gross. £	Per unit. d.	Per ton of coal. s.	d.	Net profit. £	Units sold.	Maximum load in kws.
1897	20,570	5·42	9,583	2·46	—		3,075	910,888	1,010
1898	26,112	4·60	13,481	2·37	—		1,924	1,362,786	1,707
1899	31,857	4·22	18,082	2·40	12	5	146	1,512,511	1,676
1900	37,467	4·10	25,705	2·82	18	7	− 2,558	2,191,559	2,009
1901	44,882	3·91	36,834	2·33	13	3	− 996	2,756,624	2,535

The capital expended on the Templeback station amounted to £132,031; on the Avonbank station, £94,964, and on the distributing system £148,148. The Avonbank station was opened on February 19th, 1902.

General Statement

	1900-1.	1901-2.	Inc.
Total capital expenditure ...	£299,259	£384,777	£85,518
Number of units sold	2,191,559	2,756,624	565,065
No. of 30-watt lamps connected	119,615	149,146	29,531
Maximum load in kw.	2,009	2,535	526
Gross revenue	£37,467	£44,882	£7,415
Gross expenditure...	£25,766	£26,834	£1,068
Gross profit	£11,701	£18,048	£6,347
Average price per unit sold ...	3·91d.	3·74d.	— ·17d.

The average total revenue per unit is now equal to the average sum received in the previous year for energy alone. With this exception there has been practically little change; but although the addition to the lighting demand has not been so great, the demand for motive power shows an exceedingly satisfactory development. The total number of consumers was 1,790, an increase of 283.

Source of revenue.	Sum received.	Lamps equivalent.	Units sold.
At lighting rates	£33,956	124,385	1,965,764
At power rate	1,910	19,520	310,054
For street lighting... ...	5,542	5,241	480,776

The increase in total lamp equivalent connections was 29,531, 19,400 being at lighting rates and 10,131 at power rates.

Revenue Statement.

	1900-1901. Gross.	Per unit.	1901-1902. Gross.	Per unit.	Inc.
Sale of energy	£35,674	3·91d.	£42,990	3·74d.	—·17d.
Meter rents	1,383	·15d.	1,644	·14d.	·01d.
Sale of lamps and old materials, rental of motors, work on consumers' premises, &c.	116	·01d.	95	·01d.	·00d.
Sundry fees, rents received, and premiums	294	·03d.	153	·02d.	—·01d.
Gross revenue ...	£37,467	4·10d.	£44,882	3·91d.	—·19d.

A number of payments of an extraordinary nature, amounting to £2,262, have been charged against revenue, while the coal item is still high owing to the rate per ton not having fallen to the normal. The engineering costs have all fallen, with the exception of oil, &c., marked economies having been effected in coal and repairs.

Cost of Production.

	1900-1. Gross.	Per unit.	1901-2. Gross.	Per unit.	Inc.
Coal	£11,438	1·25d.	£10,476	**·91d.**	—·34d.
Oil, waste, water, and carbons, engine room stores, &c.	726	·08d.	1,214	**·11d.**	+·03d.
Salaries and wages incurred in generation and distribution and attending public lamps.	4,598	·50d.	5,096	**·44d.**	—·06d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	3,159	·35d.	2,868	**·25d.**	—·10d.
Works costs	£19,921	2·18d.	£19,654	**1·71d.**	—·47d.
Rent, rates and taxes.. ..	2,209	·24d.	2,232	**·19d.**	—·05d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	2,625	·29d.	3,036	**·26d.**	—·03d.
General establishment charges, stationery and printing, law charges, and insurance.	831	·09d.	1,373	**·12d.**	+·03d.
Other expenses, testing, fees of electric inspector, &c.	180	·02d.	539	**·05d.**	+·03d.
Total costs ...	£25,766	2·82d.	£26,834	**2·33d.**	—·49d.

The increase in revenue of £7,415 and of costs by £1,068 only caused the gross profit to rise by £6,347, of which £4,905 was taken by additional financial charges, leaving £1,442 to reduce the net loss of £2,438 in 1900-1901 to £996. The financial result will probably be greatly improved when the new station is revenue-earning, and the current year's figures should be favourable.

Profit Statement.

	1899-1900.	1900-1901.	1901-1902.
Interest on loans, overdrafts, &c. ..	£6,020	£7,327	£10,960
Sinking fund for repayments	7,590	6,812	8,084
Net profit carried forward	165	—2,558	—996
Net profit carried to depreciation and preliminary expenses accounts.	—	120	—
Gross profit	£13,775	£11,701	£18,048

CITY NOTES.

St. James' and Pall Mall Electric Light Co.

Mr. Eustace A. J. Balfour, presiding at the annual meeting held at Carnaby Street on Tuesday, said that the position of the company had been fully maintained. The equivalent of 20,858 8-c.p. lamps had been added during the year, making the total at the end of year 232,685. On the other hand, the price of coal had been considerably reduced, so that with an increased sale of nearly one million units more than in 1901 they had a coal bill of £2,400 less. Rates were always rising, but, in consequence of the largely increased output, the standing charges had been reduced, and further economies of generation and supply had led to a saving of over ½d. per unit on the cost of electricity as delivered to the consumer. After making proper provision for depreciation and other matters, the directors recommended that for the sixth year the usual dividend of 14½ per cent. be paid. Carnaby Street station was now completed in its final form and equipped with its full steam generating plant; already two large transformers had been placed in the special room constructed for them in connection with the high-pressure supply to the Grove Road station of the Central Electric Supply Co. This supply was first given to this company in December last, and had been maintained with regularity since, giving every satisfaction. The further extension, therefore, of this company's business would be dealt with from the Central Company's works, the high-pressure currents from Grove Road station being conveyed to Carnaby Street and Mason's Yard stations, and there transformed, so that current of normal pressure could be supplied to consumers. Ample provision could be made at both of the company's stations for the accommodation of a large quantity of transforming plant without further alteration to buildings or heavy capital expenditure. An account of the capital expenditure of the Central Electric Supply Co. had been sent to the shareholders of the St. James' Co. It showed that the sum of £350,000 had been spent; this represented the cost of a large freehold site of some seven acres, and the buildings and plant equipment for 13,000 h.p., the greater part of this plant being already in position. This would be employed in giving regular service to the Westminster Electric Supply Corporation and to this company, and the ordinary share capital (£100,000) had been provided in equal moieties by the two companies, and the debenture issue of £250,000 was covered by their joint guarantee. It had been further deemed expedient by the two companies to relieve the capital account of the charges representing interest on this loan, and other necessary expenditure during the period of construction. They had, therefore, divided between them the sum of £16,704, and the St. James' half-share £8,352, was placed in the accounts as a charge upon revenue. The effect of this was to give the Central Co. a fair start, so that they would have no suspense account to be written off in a short period as a charge upon electricity supply to the St. James' Co. In view of the large capital employed, some time must elapse before it could be fully remunerative, and in the meantime the charge for the service of the two companies must be maintained at a figure to cover expenses. In view of the effect this would have on the cost of supply for a year or two to come, the board had thought it best to open a contingency account, which would be available to meet any temporary emergency. Last year they opposed the L.C.C. Powers Bill with success. This year the Council had again introduced another Bill, and though many of the most objectionable features of the Bill were removed, it still had provisions which might seriously affect the position of all electric supply companies, and the company would have once more to oppose it.

Mr. Leaf seconded the adoption of the report, and after several shareholders had offered remarks respecting the affairs of the company, some congratulatory, but one giving vent to a grumble, that after all these years the dividend ought to have been 24½ per cent., instead of 14½ per cent., the resolution was carried unanimously. The same shareholder wanted to know—when the re-election of directors came up—whether all of the directors were experts in the science of electricity. Another shareholder in supporting the directors, said "If you have men who are all experts, you will have no administration." This will interest all experts whether in the St. James' Co. or not.

The auditors were elected, and a vote of thanks to the management (Mr. Walker, the manager and secretary, and Mr. Dobson, the engineer) was passed.

Newcastle-on-Tyne and District Electric Lighting Co.

The directors' report for the year ending December 31st, 1902, states that the installations connected to the company's mains during the year were equal to 24,832 8-c.p. lamps, bringing the total up to about 86,463, and 2,107,104 units of electrical energy have been supplied as against 1,671,971 units supplied in 1901. During the last year 11,829 yards of main and branch piping and troughing have been laid, together with 22,673 yards of main and branch cable. The gross earnings for the year amount to £14,600, and, after paying the interim dividend and interest on debentures and loans and providing £500 for depreciation, the directors recommend a dividend of 5 per cent. for the half-year ending December 31st, which, together with the interim dividend paid in August last, makes a dividend of 8½ per cent. for the year, carrying forward £210. The report stated also that the Close works were now in operation, and a large demand had already been made for a supply of continuous current for both power and lighting. The whole of the interest on the capital spent upon those works during construction had been paid out of revenue. Mr. Harold Cookson, having decided to live in Africa, had retired from the board. The directors advised that Mr. W. D. Hunter, who had been engineer to the company since its inception, be appointed managing director, a position which the directors felt sure he would fill with credit to himself and the company.

The meeting of the company was held on the 6th inst. at Newcastle-on-Tyne, Mr. J. D. Milburn presiding. In moving the adoption of the report, he said that they were making extensions that were not mentioned in the report. For some time past they had had before them the practicability of extending westwards, and now he had to advise them that they had entered into an arrangement with the Council of Newburn-on-Tyne (in which there was a con-

siderable population, and many industries), by which the company was to supply the district with energy, and they were now setting about the erection of a new station in that district. It had been a question whether they should supply energy from their present station at Forth Banks, or erect a new station, and after consideration they had decided to erect a new station. They had been in communication with Benwell Council, and if, as they hoped, and was not impossible, they had to supply Benwell, they would be able to do so from the station at Newburn. The Forth Banks works were now completed, and they had in position 2,000 KW. capacity, and they had room to put in generators of not less than 20,000 H.H.P., which would serve for years to come.

Sir BENJAMIN BROWNE seconded the report, which was carried, and the retiring directors having been re-elected, the proceedings closed.

Tyneside Tramways and Tramroads Co., Ltd.

THE annual meeting of the above company was held at Newcastle-on-Tyne on the 9th inst., Mr. W. A. Watson-Armstrong, chairman, presiding. The directors' report stated that the line from Wallsend to North Shields was opened for traffic on September 4th, and the section from Gosforth to Wallsend on October 18th, 1902. The revenue account dealt with a period of about three months' working only, and the result of this showed an excess of income over expenditure of £233 5s. 9d.

The CHAIRMAN, in moving the adoption of the report, said that since September the company had made steady and substantial progress. They had been much handicapped by the narrowness of the bridge at Willington Gut preventing a double line, but this disability had been removed, and there had been a corresponding increase of traffic. As to future work, they were inquiring as to the time it would take to run a line up to Gosforth Park; and if they found they could get it done in good time for the races in June, they would do so.

Mr. J. T. MERZ seconded the report, and it was carried.

After the transaction of other business, the proceedings terminated.

Anglo-American Telegraph Co.

MR. F. A. BEVAN presided at the meeting held at Winchester House on Friday, and in moving the adoption of the report (which appeared in our issue of last week), he said that it was very satisfactory that the result of the working of the last quarter of the year had been such that they had been able to pay the preferred the whole of their dividend, and to give something to the deferred. In the first half-year there was a decrease in the traffic receipts of no less than £13,167, but in the last half there had been an increase over the corresponding period of 1901 of £9,797. In addition to that they had made £2,000 by letting out the cs. *Minia*, against nothing in the corresponding half-year. The increased total of receipts of the past half had been £11,797, which almost made up for the decrease of £13,167 in the first half. The expenses showed a slight increase of £700, but the ordinary working expenses had decreased by £640. Including the balance brought forward, there was a net increase of £7,441 available for dividend. In regard to the renewal fund, this stood at £948,473, but the securities were £14,000 below book value, and that had to be borne in mind. It looked very much as though by the end of the year, barring accidents, the renewal fund ought to come very near a million, which had always been held out as the great aim and object of the directors. About 15 years ago Lord Monk, who was then chairman of the company, held out a hope to the shareholders that when the renewal fund reached £1,000,000 they would be able to content themselves with only putting the interest on the fund to its credit instead of taking the £24,000 a year that they now took out of profits. He (the chairman) wished to again emphasise to the shareholders the fact that that quasi-promise was made 15 years ago, since which time their cables had been necessarily more or less deteriorating; that they had now cables which had been laid for 30 years—they being laid in 1873 and 1874; that they had a great system of inter-island cables on the other side which had been patched again and again. There was no doubt that at no distant date they would have to spend considerable sums in renewing those inter-island cables, if they were fortunate in escaping the renewal of one of their ocean cables. Their repair ship was also an old one, but still very good. He would not like shareholders to go away from that meeting with any certainty that they would be able, even at the end of the present year, to take anything less from the profits for keeping up their plant. In these days of keen competition the directors felt it to be most important to keep up their cables and plant in a high state of efficiency, otherwise they would not be able to compete with others. In regard to the Pacific cable which was opened for traffic last November, some shareholders had thought that this company would have a large increase of traffic therefrom. The directors never were very sanguine about that, and shareholders would, perhaps, be disappointed to hear that they had not had any large increase—in fact, if anything, there had been a small decrease. The explanation was a very simple one. The tariff to Australia by the new Pacific cable and by the old route of the Eastern Extension cable was exactly 3s., and there was no particular reason, therefore, why English merchants and others sending from England should send by the new route instead of by the old one, which had served them so well. But when they came to the messages from America and Australia, of which they used to receive a certain amount, as they could only come *vid* Europe, there was a definite gain to the American, because, instead of having to pay 4s., as he used to do, he can now send his message to Australia for 2s. 8d. The result, naturally, was that this company had lost all the traffic between America and Australia, and there was not much gain, if any, upon the traffic between Europe, and going from Europe by America to Australia. Maybe the traffic would afterwards increase, but at present they had really gained nothing from the Pacific cable. Mr. Bevan then proceeded to refer to wireless telegraphy, and discussed the messages between President Roosevelt and the King. No independent experts had been allowed to see the working of the Marconi system, so far as he was aware, and he did not think that any pressmen on this side of the Atlantic had seen the working at Poldhu. A few days ago five American pressmen were admitted to see the working of the Marconi system on the other side. Mr. Bevan then proceeded to read certain interesting and remarkable statements which were written by one of these journalists in the *Boston Herald* for January 23rd, much to the enjoyment of his hearers. One of these statements went to show that there seemed to be a brass key and a wooden key, and Marconi explained that the wooden one was a more satisfactory instrument in getting clear signals, and that the brass one was faster in its operations. It was experimenting with the wooden one "last Monday," in sending the President's message with a view to seeing how fast he could work it, that led to what turned out to be an inadvertent sending of the message. The *Herald's* statements showed that unless very great care was taken with the Marconi system, some terrible accident might ensue. Supposing, however, they were to take it for granted that Marconi, in the course of a few months or years, was able to transmit his messages from both sides of the Atlantic, what would be his position? He would be in competition with 14 cables, all of which could work with perfect accuracy, with perfect secrecy, and a speed which, even if approached, certainly could not be excelled; therefore he could not see why the Marconi system should be a matter of such dread as it seemed to be to some of the holders of telegraph shares, when they bore in mind that this company could send messages from this side to New York in half a minute, and that, barring the fallibility of operators, with absolute accuracy and perfect secrecy. Marconi would have to compete with that system; and however successful he might be, it would take a lot of beating. Since the last meeting, Mr. Bevan continued, he had been on a visit to their stations in New York and Canada. He found the staff working with the utmost zeal. The competition was very intense, but every effort was being made to secure traffic for the Anglo cables. The speaker then gave figures showing how the traffic had gone ahead since 1890, and paid a high compliment to Mr. Carson, the general manager, and to Mr. Williams, their manager at Shorter's Court.

The adoption of the report was seconded by Sir GERALD FITZGERALD, and after a few questions had been answered, was carried unanimously.

The retiring directors and auditors were re-elected, and the usual vote of thanks closed the meeting.

Dublin United Tramways Co.

THE half-yearly meeting of this company was held on February 3rd, was and presided over by Mr. W. M. Murphy, who said it was gratifying to notice that the receipts continued to increase; they amounted to £132,240 for the half-year, an advance of £3,833, of which £3,540 was due to passenger traffic and £203 to other receipts. There were no exceptional conditions or any special circumstances to account for this increase, which must, therefore, be attributed to the inherent tendency of tramway traffic to expand. The net result of the half-year's working was that, after paying all fixed charges, they had £40,240 left, which enabled the company to pay a dividend of 6 per cent. on the ordinary shares, and to carry forward £5,365, as against £4,668 last year. An examination of the expenditure side of the account would show that the company had surpassed all its previous records in the low cost and high efficiency of electrical operation. When he last addressed the shareholders, he thought that, having brought the cost of generating electric energy to a little over ½d. per Board of Trade unit, they had reached a minimum figure, but their costs for the last half-year worked out as low as ·442d.—that was to say, well under ½d. per unit. Portions of their plant had now been in operation for more than six years, and most of it for three or four years, and it was gratifying to find that, while it had been kept in good condition, the cost of maintenance had been diminished rather than increased.

Bristol Tramways and Carriage Co.

AT the annual meeting held at Bristol on 9th inst., Mr. George White stated that the tramway receipts continued to show expansion, and had amounted to £197,132, an increase of £20,101. The total number of passengers carried on the tramways was 41,192,899, an increase of 4,477,993. The percentage of increase in the various items were so interesting that he would like to refer to them. The increase in the tramway department was 11·35 per cent., and in the tramway passengers 12·2 per cent. The profits for the year amounted to £82,017, against £70,382, an increase of 16·5 per cent. The capital account had been almost stationary, the increased outlay being only 2·1 per cent. The directors had every confidence that the receipts would continue to show an increase; while, on the other hand, the capital account would move slowly until further extensions were taken in hand, in which case they would, of course, anticipate further development in traffic. There were still districts connected

with the city which were not adequately served by the existing 29 miles of route, and the company was willing to supply the deficiency if the Corporation would meet it in a fair spirit.

Blackheath and Greenwich District Electric Light Co.

THE directors' report for the year ending December 31st, 1902, which was presented at the meeting held at Cannon Street Hotel on Wednesday, February 11th, reads as follows:—

The revenue account shows that the total receipts for the year were £14,334 5s. 2d., and the charges £6,978 18s. 10d., leaving a balance of £7,355 11s. 4d. To this has to be added £1,694 14s. 9d., the amount brought forward from last year's account, making the available balance £9,050 6s. 1d. The interest on debenture stock absorbed £4,500, and after providing for other interest charges, there remains a net balance of £4,012 16s. 2d. The directors recommend the payment of dividend to December 31st, 1902, on the amounts paid up on the 7 per cent. cumulative preference shares, amounting to £103 1s. 9d.: that £1,000 be placed to credit of depreciation fund, and that the balance of £2,909 14s. 5d. be carried forward. The business of the company continues to show steady progress, as will be seen by the following comparative figures:—

Year.	8-c.p., 35-watt lamps.		Number of consumers.	Gross receipts.	Expenditure.	Net receipts.
	Connected at end of year.	Increase.				
				£ s. d.	£ s. d.	£ s. d.
1900	14,473	14,473	342	4,195 2 1	4,050 4 2	144 17 11
1901	29,449	14,976	746	7,808 9 7	5,658 5 4	2,150 4 3
1902	44,916	15,467	1,234	14,334 5 2	6,978 18 10	7,355 11 4

With a continuance of this progress, the directors look with confidence to the future prosperity of the company. The issue of 50,000 7 per cent. cumulative preference shares of £1 each, offered to the holders of the company's shares and debenture stock was largely over-subscribed. The premium from this issue has been applied in reduction of preliminary and issue expenses, which item has accordingly been reduced from £10,372 7s. 3d. to £7,872 7s. 3d. The directors have given notice of an application to Parliament for a Bill to authorise the acquisition by this company of the electric supply orders for the adjacent districts of Lewisham and Penge. These districts can be supplied conveniently and economically from the Blackheath Co.'s system, and the combination of the several districts into one area of supply will be beneficial to the public and to this company. The terms of agreement with the local authority of Penge have not yet been settled, and unless terms acceptable to both parties are arranged, this part of the Bill may not be proceeded with. The Bill also proposes to authorise the sale to this company of the whole or part of the Crystal Palace Co.'s undertaking, subject to satisfactory terms being settled. This power, if sanctioned by Parliament, will not be exercised without the previous knowledge and approval of the shareholders of both companies. An extraordinary general meeting will be held to consider the Bill, and, if approved, to pass the requisite resolutions.

Central London Railway Co.

THE fifteenth ordinary general meeting of the shareholders of this company was held on Wednesday last week at the Holborn Restaurant, Sir Henry Oakley in the chair.

The CHAIRMAN, in proposing the adoption of the report, said that, dealing first with the question of capital, the expenditure had been very small; the two material sums, amounting to £6,200 and £3,900, had been expended at Shepherd's Bush. Four additional lifts had been built, and they had been found of great convenience to the passengers. They had also enlarged their sheds there, and laid down a few extra lines in the yards. Passing to the revenue, they earned in the six months £181,000, as compared with £168,000 in the corresponding half of 1901; the receipts, therefore, increased by £12,747, or nearly £500 a week. The passengers carried numbered 22,425,776, an increase of 1,623,000 in the half-year. The receipts and number of passengers bore practically the same relation to each other, but there was a slight variation, due to the increase in the number of workmen carried, which had reduced their average earnings per passenger from 1·88d. to 1·87d. They carried 2,770,854 workmen in the six months, and, taking their double journey into account, they carried about 18,000 a day at the reduced rate of 1d. There was a feature in the report about which the company were somewhat indignant, viz., the item for rates and taxes, which this past year was £7,876 in excess of what it was in last year's accounts. The basis upon which they were assessed was, they thought, oppressive in the highest degree. They had made the railway at considerable risk to the proprietors, and in the making of it had caused the property near which it ran to increase in value, and yet they were taxed to the extent of 20 per cent. on their earnings. The rapid manner in which rates and taxes were increasing had engaged the attention of all railway proprietors, and a committee representing the principal companies had been appointed to consider the question, and he hoped something might be done to alter the basis of assessment. The result of the working was that they proposed a dividend of 4 per cent. practically all round, after providing for the dividend on the deferred stock, that was earned in the first half of the year. That would leave a very considerable balance, and they recommended them to appropriate £10,000 as an addition to the reserve fund, and to carry forward the balance of £27,000. The railway on the year had earned a 5 per cent. dividend, and if they had put nothing to reserve they could pay 5 per cent., and carry forward a small balance, but having regard to the somewhat special conditions which influenced the working of a new undertaking like theirs, the board were unanimously of opinion that it was inadvisable to divide their profits up to the hilt. The conditions of electric working were improving day by day. The railway had only been open 2½ years, and in that time they had found it necessary, expedient and profitable to make alterations in many of the details of the machinery with which they started, and which at the time of starting were the best then known. Those features were presenting themselves constantly to the board, as they and others gained experience, and therefore they thought it most advisable that they should keep some money in hand so that they might be able to take advantage of any improvement which came along and be enabled to keep the railway both in its working and all other conditions up to the standard they had set themselves to gain, and that was to make it as bright, convenient, comfortable and quiet as it was possible for a railway of that kind to be made. Then, too, they would have heavy Parliamentary expenses to meet if their Bill was to go forward this session. Many complaints had been made as to the ventilation of the tunnels—he would not say they were unfounded, but they were exaggerated. The board had given that question the gravest attention, and had called to their aid the best scientific advice they could get. They had decided to establish a huge fan in the railway at Shepherd's Bush, which would be driven by electric power and which would be sufficiently powerful to exhaust the air in the tunnels in an almost inconceivably brief space of time, so that they would be able to keep a current of air more or less constantly going, and at night, by closing the doors of every station so as to ensure the tunnels being practically sealed, they would pump out the whole of the air in the tube, so that they would start in the morning with the highest degree of purity possible. At the Bank station they would force air into the dead end of the tunnels, where the trains shunted, and drive the foul air out there. The engineer whose advice they were taking on the matter had told them that those precautions would be sufficient. As the shareholders knew, the board had decided to comply with the recommendation of the Vibration Committee by using motor-cars for the trains instead of engines. They had made arrangements to obtain the motor-cars for the purpose, and he believed that in the course of a month or six weeks they would have a very substantial number of their trains running by that method. For some time past they had had two such trains running in order that they might gain experience as to their efficiency and economy, and they had satisfied them on both points. The question of cost would have to be considered in connection with the reserve fund. As to the Bill which was rejected last year, the board, in view of all the surrounding circumstances, unanimously recommended that it should be introduced again this year. The Royal Commission on locomotion which had been appointed, would, he believed, not simply consider the schemes deposited in Parliament, but would look at the matter in a broad light to see what was best for London, having regard to the railways already existing, and to those for which power had been granted. They hoped to put before the Commission so many merits in the suggestions they would lay before them, that they hoped they would meet with their approval. It might be that none of the Bills would get forward this session; but if any decision or recommendation was made by the Commission to Parliament as to the course which should be taken, they thought they ought to be in the position to take advantage of it. There were several schemes suggested; but whatever scheme was sanctioned, they were confident that no one could touch the sources of their traffic, although, of course, there might be other injurious effects which they could not foresee. They wanted to be in the position to show fight when they reached the field of battle. Having examined the probable traffic by the route they proposed to take and comparing it with the traffic which existed before their present line was opened along Oxford Street, they saw no reason to doubt that the enterprise would be successful, and they were certain that the combination of a continuous route throughout London would enable them to offer advantages incomparably greater than could be given by any other combine.

Lord COLVILLE of Culross seconded the resolution, which, after some discussion, was agreed to.

Subsequently, an extraordinary meeting was held at which it was agreed to re-introduce the Bill for extending the railway, in the present session of Parliament. The following resolutions with regard to the raising of fresh capital were also carried:—

1. That pursuant to the powers conferred by the Central London Railway Act, 1902, £150,000 additional ordinary capital of the company be raised by the creation and issue of 15,000 new shares of £10 each, but so that no share shall vest in the persons accepting the same, unless and until a sum not being less than one-fifth of the amount of such share shall have been paid in respect thereof, and the directors are hereby authorised to dispose of such new shares in such a manner as they may think most beneficial to the company.
2. That, pursuant to the powers conferred by the last-mentioned Act, and subject as in such Act provided, the company do, in respect of the said additional capital of £150,000, which they are by that Act authorised to raise as aforesaid, borrow on mortgage of the undertaking sums not exceeding in the whole £50,000.

Northampton Electric Light and Power Co.

THE directors' report for 1902 says that the equivalent of 3,846 8-c.p. lamps (in lamps and motors) was added during the year, thus bringing up the total to 32,967. The municipal purchase negotiations fell through, and the directors quoted for supplying energy for working the Corporation tramways, but their offer was declined. The time had arrived for considerable development of the business. A large amount has been spent out of the year's revenue upon repairs and maintenance. In response to applications received from outside the area, the company was applying for a prov. order to extend its supply to outlying districts. The whole of the capital had now been raised, and shortly a meeting will be called to authorise an increase. The available balance for the year was £1,893. The dividend on the ordinary shares was 4½ per cent., as compared with 3½ per cent. in the preceding year; £73 is carried forward.

Cambridge Electric Supply Co.

The directors' report which was submitted at the meeting held on Wednesday, says that the rapid increase in the company's business during 1902 renders it expedient that a new site should be obtained and a new generating station erected if they are to be in a position to cope with the demand which has grown and is growing beyond all anticipation. So many applications have been received (amounting at present to over 1,000 lamps) for a supply of energy to premises just outside the borough, that after careful consideration, the directors decided to apply for Parliamentary powers to enable the company to supply in the surrounding district, and negotiations have been commenced with the Corporation of Cambridge which it is hoped will lead to a satisfactory result. During the year 1902 there has been added to the company's mains the equivalent of 3,833 8-c.p. lamps, making the total 38,556. The number of units supplied has been 431,379, an increase of nearly 50,000 units. The company after paying all charges, and placing £1,000 to depreciation account, has a balance of £5,965 5s. 8d., which, added to £118 19s. 10d. brought forward from last year, makes £6,084 5s. 6d. An interim dividend of 2½ per cent. (absorbing £1,769 9s. 3d.) and interest on temporary overdraft and loan (£121 4s. 11d.), have already been paid, leaving a net balance of £4,193 11s. 4d. Out of this the directors recommend the payment of a dividend of 4½ per cent., making 7 per cent. for the year. This will absorb £3,505 11s. 6d., leaving a balance to carry forward subject to fractional adjustment of income-tax, of £687 19s. 10d.

Smithfield Markets Electric Supply Co.

The directors' report for the year 1902 reads:—

The gross profit for the year amounts to £6,066 12s. 3d., an increase of £1,759 over the previous year. The gross receipts show an increase of £2,314. Interest and other charges absorb £2,464 10s. 5d., and a further sum of £1,000 has been placed to depreciation fund, which now amounts to £3,000. It has been considered advisable to write off the whole of the balance outstanding for preliminary expenses, provisional order expenses and consulting engineer's fees, amounting to £1,062 14s. 1d., and to make provision for the discount on the issue, and premium on the redemption of the second debentures, amounting to £800, a total of £1,882 14s. 1d., thus relieving future accounts from any further charge under these heads. The amount remaining to be dealt with, including £2,499 15s. 11d. brought into the accounts from last year, is £4,850 18s. 7d. Of this sum, £2,000 has been placed to a general reserve fund, and the directors propose to divide the balance as follows:—

(1) By the payment of a dividend at the rate of 2½ per cent. on the ordinary shares	£1,500	0	0
(2) And to carry forward	1,350	18	7
	£2,850	18	7

A satisfactory reduction has again been effected in the cost of production and under favourable conditions it is hoped that this will be continued during the current year. The directors have decided to replace one of the present generating sets by one of larger capacity, and most modern type, to meet the increasing business, and this will be ready for use in the early autumn. The plant and machinery have been properly maintained out of revenue and are in a satisfactory condition. The following table shows the progress of the business from the commencement:—

Year.	No. of consumers.	Lamps.	Total revenue.	Gross profit.
1898	158	9,723	£6,501	£384
1899	266	16,960	£12,083	£1,560
1900	323	23,239	£15,187	£2,952
1901	351	25,870	£18,251	£4,307
1902	371	27,694	£20,565	£6,067

The meeting is to be held at Winchester House to-day at 12 o'clock.

Waterloo and City Railway Co.

The 18th half-yearly general meeting of this company was held on Thursday, February 5th, at Waterloo Station. Sir Charles Scotter took the chair. In moving the adoption of the report, Sir Charles said that the various questions which had been somewhat prominent in the Press lately, with reference to American railway methods, did not affect a little line like the Waterloo and City. Referring to the report, he said there had been an expenditure during the half-year of £1,183. This amount, although paid during the half-year, was for work which would not be completed for two or three years. A great proportion of the amount was a balance due to the Central London Railway Co. for the construction of subways. There was also included a small sum for signals. The receipts of the company had been progressive from the day of its opening up to the present time. The gross receipts of the line, less Government duty, amounted to £17,587; the working expenses had been £7,818. A dividend at the rate of 3½ per cent. on the ordinary stock was recommended. The number of passengers carried during the half-year was 2,307,141, an increase of 116,609 over the corresponding period of 1901. The season ticket-holders on December 31st last, numbered 1,243, as against 1,030 at the end of December, 1901. Referring to the administration of the line, the Chairman said that the charges in this connection were less than on any other railway in the country. A gratifying fact was that there had been no accident of any kind during the whole of the half year. The line had been worked in a splendid manner by the South-Western Co., and as to the punctuality of the trains, that was now proverbial. Among one or two matters which they intended to urge on the South-Western Co., was the improvement of the lighting of the stations. He was sure that the more the railway was known the more it would be appreciated. In referring to the retirement of Sir Wyndham S. Portal, Bart., who had been chairman of the company from the commencement, the chairman said that that gentleman had always taken the greatest interest in the welfare of the railway. Both he and his co-directors wished Sir Wyndham every happiness in his retirement. The motion for the adoption of the report was seconded by Lieut.-Col. Campbell, the deputy chairman. A Mr. Bravington thought that the erection of lifts at each end of the railway would be a great advantage, and in reply the chairman stated that the matter had been fully considered by the directors, who came to the conclusion that the slopes at present in use were safer and more convenient than lifts.

The report was unanimously adopted.

Imperial Tramways Co.

The directors' report, to be submitted at the meeting to be held at Bristol on Wednesday, February 18th, gives the following facts respecting the working of the subsidiary undertakings during 1902:—

Middlesbrough, Stockton and Thornaby Electric Tramways.—The gross receipts of these electric tramways amounted to £49,254 18s. 4d., and the number of passengers carried to 9,367,027, compared with totals of £48,772 17s. 1d. and 9,141,188 in the preceding year. The net profit for the year is £16,125.

London United Tramways (1901), Ltd.—During the year the exchange of securities consequent on the reconstruction of this company was duly carried into effect, the Imperial Co. receiving 34,800 5 per cent. preference and 12,000 ordinary shares and £55,800 in cash, and subsequently subscribing for a further 4,500 ordinary upon which £1 per share only was called up. As the shareholders are cognisant, 5,000 of the fully paid ordinary shares were distributed amongst them in specie by way of interim dividend in April last, and the directors now have the pleasure to report that they have disposed of the remaining 7,000 fully paid and 4,500 £1 paid ordinary shares upon conditions resulting in a very substantial profit to the Imperial Co. The company's interest is now represented by 41,500 fully paid 5 per cent. cumulative preference £10 shares, and inasmuch as the London United Co. pays dividend at the rate of 8 per cent. on ordinary capital of an equivalent total amount to the preference capital, it will be seen that the preference shares are unusually well secured, and afford an excellent investment for the employment of this company's funds.

General.—The company's revenue account for the year shows exceptional results by reason of the important transaction in London United ordinary shares referred to above. After payment of the interest on debenture stock and dividend on preference shares for the whole year, and the cash interim dividend on the ordinary shares, there remains a sum of £143,645 5s. 10d. for disposal. The directors recommend that the sum of £100,000 be now appropriated in the payment of a final dividend for the year of £5 per share on the ordinary shares, that a further sum of £43,000 be carried to a special account, viz., "ordinary dividend fund," to be available for future distribution amongst the ordinary shareholders, and that the balance of £645 5s. 10d. be carried forward to the credit of the next year's account. The difference in value in favour of the company resulting from the exchange of London United securities has been credited to the contingencies fund, so that the total of the reserve funds has been increased from £92,470 to £120,471.

National Telephone Co.

The report for the half-year ended December 31st states that the income accrued in respect of the business of the half-year amounts to £868,462, as compared with £801,495 for the corresponding period of 1901. The working expenses amount to £473,267, as compared with £444,391. The net result for the half-year (after deducting the Post Office royalties, amounting to £78,641) is a profit balance of £316,553, as compared with £283,680 for the corresponding period of 1901, being an increase of £32,873. The rentals carried forward for unexpired terms of running contracts amount to £771,102, as compared with £730,624. Out of the available balance of £261,451 the board will recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 4½ per cent. per annum on the deferred stock, being equivalent to 5 per cent. per annum on the ordinary shares now divided into preferred and deferred stock, less tax in all cases. The board also propose to transfer £105,000 to reserve and to carry forward £12,451. The sum of £259,050 has been expended on capital account during the half-year in the erection of 12,286 additional exchange and private stations, and in the construction of underground works.

Companies Struck Off the Register.

The following companies have been struck off the Register:—

Cornforth Patent Smoke-Consuming Apparatus Co.
Dowson Economic Gas Co.
I.E.S. Accumulator Co.
Nalder & Harrison Construction Syndicate.
New-Mayne Electric Rudder-Motor Syndicate.
St. Martin's Electrical Manufacturing Co.

Charing Cross and Strand Electricity Supply Corporation.—Mr. Fladgate presided at the meeting on Wednesday, when the report was adopted. A sum of 1,500 guineas was voted to the directors for the year. Sales of current in the city area had realised £27,774 during the year, and it is expected that this will be more than doubled during 1903. Contracts had been signed for 30,000 additional lamps in the city, and negotiations were proceeding for a further 100,000.

Kensington and Knightsbridge Electric Lighting Co.—The directors recommend a dividend at the rate of 10 per cent. per annum for the half-year ending December 31st, 1902, carrying forward £5,832 19s. 8d.

Metropolitan District Railway Co.—The report just issued says that active progress is being made by the Underground Electric Railways Co. of London, Ltd., with the work of electrification. Arrangements have been, and will continue to be, made with the Metropolitan Co. so as to secure uniformity of electrical equipment.

City of London Electric Lighting Co.—The directors, after placing £35,000 to reserve, recommend the payment of a dividend of 10s. per share (at the rate of 5 per cent.) on the ordinary shares for the year ended December 31st last. The sum of £20,000 will be carried forward.

Telegraph Construction and Maintenance Co.—The directors propose paying a dividend of 10 per cent. (£1 4s. per share), together with a bonus of 5 per cent. (12s. per share), in addition to the 5 per cent. already paid, making 20 per cent. for the year 1902.

London Electric Supply Corporation.—The profit for the year ending December 31st, 1902, is £35,342 5s. 11d., as compared with £25,220 8s. 2d. for 1901. After paying interest there remains a balance (including £1,489 19s. brought forward) of £22,522 16s. 3d. The board recommend that this amount be dealt with as follows:—By payment of a dividend of 6 per cent. on the preference shares for the year ending December 31st, £14,952; to reserve account, £6,000; to be carried forward, £1,570 16s. 3d.—£22,522 16s. 3d.

Morley Electrical Engineering Co.—The annual meeting was held at Bradford on 6th inst., Mr. Harry Fox presiding. The chairman stated that the profits for the year amounted to £968, after paying for debenture and loan interest, bad debts, &c. It was decided to pay a dividend of 10 per cent. on the share capital, to write off the adverse balance on January 1st, 1902, and to carry forward £239.

National Gas Engine Co.—The report for 1902 states that the net profit for the year, after deducting depreciation on buildings, tools, &c., and allowing for trade expenses and management salaries, is £26,497. The directors propose to pay a dividend at the rate of 5½ per cent. per annum on the preference shares, 12 per cent. per annum on ordinary shares for the six months ended December 31st last (making 10 per cent. for the year). This will absorb £8,202, leaving a balance of £14,178, out of which the directors propose to place £5,000 to the special reserve fund, making it £25,000, and to carry forward £9,178.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—Charing Cross and Strand Electricity Supply Corporation, Ltd.—Further issue of £50,000 4 per cent. debenture stock (redeemable). The Committee ordered the under-mentioned securities to be quoted in the Official List:—Callender's Cable and Construction Co., Ltd.—Further issue of £110,000 4½ per cent. first mortgage debenture stock (redeemable).

Blackpool and Fleetwood Tramroad Co.—The report to be submitted at the meeting on the 20th inst. states that, including the sum brought foward from last half-year, the balance of profit, after providing for debenture interest, is £10,228, and the directors recommend a dividend at the rate of 9 per cent. per annum, which will absorb £6,750, also to write off £1,500 to depreciation reserve, leaving a balance of £1,978 to be carried to the current half-year. The number of passengers carried during the half-year was 1,369,937. The receipts from all sources amounted to £21,031.

London United Tramways (1901) Co.—The annual meeting of this company was held at Chiswick on Wednesday, when the report to December 31st last was adopted. The gross receipts were £222,256, and the expenses £120,938, leaving £101,318 as net revenue. A final dividend of 8 per annum has been declared on the ordinary shares making 8 per cent. for the year. 36,209,737 passengers were carried.

STOCKS AND SHARES.

Wednesday Evening.

With apparently plenty of money in Lombard Street, there is still a great dearth of business in the Stock Exchange, and the general body of investors remain aloof from gilt-edged markets, even as the more speculatively inclined refuse to support the gambling departments. The fair promises of better trade, which the House congratulated itself upon at the opening of the year, have, so far, proved only illusions; there is a lack of confidence still evident, and members of the Stock Exchange pathetically complain that they will be unable to meet their subscriptions for the new House twelvemonth which begins at the end of March.

No doubt can be entertained that, when business does show signs of returning to Capel Court, the electric supply market will feel the full benefit of the greatly improved conditions made plain by the reports now being issued. In fact, the advance may be said to have already commenced. In the list of supply companies, taking the provincial undertakings into account, there are about a dozen rises chronicled this week against a solitary fall. The latter has occurred in South London shares, where the dividend of 1¾ per cent. appears to have disappointed some of the optimists, although it slightly exceeds the cautious estimate referred to in this column last week.

Naturally, the Metropolitan award is the chief subject of interest at the moment. Notwithstanding the calm attitude adopted in certain quarters with reference to the arbitrator's figures, we may remark that the award is hailed with considerable delight by insiders. The price of the shares has oscillated between 18 and 21 since the announcement was made known, and is now settling down to about 18¼. Well-informed circles put the intrinsic value of the shares at 21 to 22, but, of course, the rise brought in a number of profit-takers, and prudence suggests that as there are several points to be taken into consideration before a definite value can be arrived at, it is well not to be over-sanguine just yet. The raising of the money by the Marylebone authorities, and the price to be paid in connection with the Sardinia Street station, are two of the niggers in the hedge which at the moment constitute unsettling factors.

Incidentally, it may be mentioned that the market is estimating that the dividend to be declared shortly on Metropolitans will be about 1 per cent. better than that for the corresponding period in 1902.

One of the best reports issued within the past few days is the Brompton and Kensington. The directors, in writing off the item of goodwill in the balance-sheet, are pursuing a policy that might well serve as a model to other companies, and we may venture to hope that their excellent example will be followed in many cases. The recent criticism directed against electric supply finance is bearing fruit already; that must necessarily advance the market in the good estimation of the investing public to no small extent.

British Electric Tractions have fractionally hardened, but Cape Electric Trams are rather easier at 2 7/16. London United Ordinary remain unaltered on the declaration of the 8 per cent. dividend, and keep about 19, with only buyers in the land. The Debenture stock, after being a quiet market for several weeks past, is coming into demand again. Both the principal omnibus companies show greatly improved results in regard to the final half of 1902, increased receipts synchronising with reduced expenses. It would seem as though the tube and tram competition had spent the worst of its force, at all events for the time being, although with the prospect of ever-widening, ever-narrowing rings of Tube enterprise the bus situation is fraught with considerable speculation.

City and South London Ordinary stock keeps hardily strong, and all the constantly-repeated misgivings of an evening journal as to the effect likely to be made upon the line by the opening of the South London electric trams, are helpless to stop the rise in the Ordinary stock, now up to 80. Central London and Waterloo and City issues are also steady, the latter a point up on the week. So far as the Twopenny Tube is concerned, market interest centres upon the probable fate of the company's Bill when it again appears in committee. An impression is abroad that the appointment of a new commission to deal with the problems presented by the street traffic of London may serve to throw back Tube schemes for months.

Marconics are now becoming as much a daily feature as the weather reports, but Eastern Ordinary is up 5 points, and Eastern Extensions a sovereign, while other prices in the Telegraph section are also harder.

The fine report just published by the National Telephone Co. has failed to move the prices of the stocks, only the 3½ per cent. Debenture changing on the week. Doubtless a good part of the improvement had been discounted, and it now appears rather as though the recent buying were based on inside information. Henleys have slipped back ½ to 16 middle, but on the whole the Miscellaneous section is decidedly steady.

Finchley Overhead Wire Appeal.—On Wednesday was heard the appeal of the Finchley Electric Light Company, Limited, from an order made by Mr. Justice Farwell dismissing their action brought against the Finchley U.D.C. to restrain them from carrying out a threat to cut their wires. The case has already been reported in the Review. Their Lordships now decided that what was vested in the local authority was so much of the area above, and so much below, as was necessary for ordinary use as a street, and that the wires in question, which were carried across the roadway at a height of 30 ft., were clearly outside the Council's area of use. They accordingly allowed the appeal, and granted a perpetual injunction with costs.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Feb. 4th.	Closing Quotations Feb. 11th.	Business done week ended Feb. 11th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	96 —100	96 —100	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3¾%	6¼%	60/6	47 — 50	47 — 50	47⅛	..
3,105,880	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89 — 91	90 — 92	91	89½
3,105,880	Do. do. do. Deferred	Stock	5s. %	3s.	1/-	7¾— 8⅛	7¾— 8⅛	8⅛	8
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4 — 4½	4 — 4½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —180	170 —180	..	..
1,841,200	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	92½	91
16,000	Cuba Telegraph	10	4½%	4 %	..	5 — 6	5½— 6½	6⅛	5½
6,000	Do. 10 % Pref.	10	..	..	..	13 — 14	13 — 14	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	..	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	7	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10½	10½— 11	10⅝	10⅜
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	112 —117	117 —122	121	116
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	84 — 87	85 — 88	86	84
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106⅜	105⅜
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10½— 11½	11½— 12½	12⅛	10⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	107 —110	105 —108	106⅛	105⅛
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102 %	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8 — 8¼ xd	8½— 8⅝	8½	8⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 13 xd	11⅞— 12⅞	12⅝	11⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	..	23 — 25	25 — 27	26⅛	22½
66,300£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	..	37 — 41	37 — 41	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	2½%	..	⅛— ¼	⅛— ¼	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	¾— 1	¾— 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	97 — 99	97 — 99	99	98
1,966,667	Do. do. Def. Stock	100	..	..	4½%	70 — 72	70 — 72	71⅛	69½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11¼— 12¼	12 — 13	12⅛	12½
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛	4¾— 5⅛	5⅛	5
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 96	95 — 97	96	95
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	101⅞	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	¾— 1	¾— 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	6½	..
3,303	Submarine Cables Trust	Cert.	..	..	..	110 —120	105 —115	107	106
58,000	United River Plate Telephone	5	7 %	7 %	..	5 — 5½	5½— 5⅝	5⅝	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5	4½— 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	100 —103	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	96 — 99	96 — 99	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	10 — 11	10½— 11½	11¼	10⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	98 —101	100	..
88,321	West India and Panama Telegraph	10	2½%	..	..	⅝— ⅞	¼— ⅜	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	4½— 5½	4½— 5½	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	2½— 3½	2½— 3½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	..	..
100,000	British Electric Traction	10	9 %	9 %	..	13 — 13½	13 — 13½	13½	13½
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12½	12½— 12⅞	12⅞	12½
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	124 —127	126	125½
100,000	British Insulated Wire Ord.	5	15 %	10 %	..	7½— 8	7½— 8	7⅝	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5½— 6 xd	5½— 6	5⅝	5½
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	8 %	Nil	..	12/6 to 13/6	12/6 to 13/6	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16/6 to 17s.	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	..	¾— 1¼	¾— 1¼	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	..	1 — 1½	1 — 1½	1⅛	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	100 —103	101 —104	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	91 — 96	91 — 96	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	14 — 15	14 — 15	14⅜	14⅛
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½— 6	5¾— 6	5⅞	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	108 —111	108 —111	110½	107⅞
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	105 —108	105 —108	107	105
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	113 —116	113 —116	113½	..
1,390,000	City and South London Railway	Stock	1½%	2 %	3½%	77½— 78½	76½— 77½	79⅛	78½
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2½— 3	2¾— 3	2¾	2⅞
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —106%	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	⅛— ⅜	⅛— ⅜	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½— 2½	1½— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	74 — 78	73 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1½— 2 xd	1½— 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 3	2⅝— 3	2⅝	..
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	10 — 10½	10¼	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	100 —103	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	..	16 — 17	15½— 16½	16⅛	15⅝
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5½— 5⅝	5½— 5⅝	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —113	109 —113	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	18½— 19½	19½	19
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	101 —104	101 —104	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅞— 6	5⅞— 6	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10⅝— 10⅞	10⅝— 11	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14½— 15½	14¾— 15½	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	37 — 40	37 — 40	38	37½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	97 —100	100½	100

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.
‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ¼—⅛.
National Electric Free Wiring, ½—1.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years.			Closing Quotations Feb. 4th.	Closing Quotations Feb. 11th.	Business done week ended Feb. 11th, 1903.	
		‡	1900.	1901.	1902.			Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	3/8 — 1/2	1/4 — 3/8	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	110 —118	114 —117	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	..	10⅛ — 10⅜	10⅛ — 10⅜	10⅜	10⅛
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10 — 10⅛	10 — 10⅛	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9⅞ — 10	9⅞ — 10	9⅞	9⅞
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛ — 6	5⅛ — 6	5 5/16	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	4 15/16	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	104½	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	..	5⅛ — 5⅜	5 — 5⅛	5 1/16	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10 — 11	10 — 11	10½	10½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13¼ — 14½	13¼ — 14½	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	..	8¾ — 9½	8¾ — 9½	9⅜	8⅞
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	6 %	..	..	12 — 13	12 — 13	12⅝	12⅜
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	108 —111	108 —111	109½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6½ — 7 xd	6½ — 7	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6⅛	6 1/16	6 1/16
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108 xd	106 —109	106¾	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10 — 11	10½ — 11½	11	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	100 —103 xd	100 —103	..	..
110,000	ondon Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛ — 5⅞	5⅛ — 5⅞	5 7/16	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	99	98½
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	..	16½ — 17½	18 — 19	20	18 1/16
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	107 —112	107 —112	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	..	14 — 15	14½ — 15½	14½	14 1/16
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ — 15½	14½ — 15½	15 1/16	15
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	..	8½ — 9½	8½ — 9½	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	2 — 2¼	2¼ — 3	..	..
50,000‡	Do. do. 4% Deb.	100	..	..	..	80 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3⅜ — 4	3½ — 3⅝	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	13	12⅞
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½ xd	6 — 6½	6⅝	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 11th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ...	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23 15	£19 10	£4 5s. inc.
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3½.	3½.	..
a ,, Caustic (75/80%).. ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	119/-	125/-	6s. dec.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	2½d.	..

METALS, &c.		This week.	Last week.	Inc. or Dec.
b Aluminium Ingots, in ton lots ..	per ton	£148	£148	..
b ,, Wire, in ton lots ..	per ton	£224	£224	..
b ,, Sheet, in ton lots ..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£40 to £130	£40 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	6¼d.	..
c ,, Tube (brazed)	per lb.	8¼d.	8¼d.	¼d. inc.
c ,, ,, (solid drawn).. ..	per lb.	7d.	6¾d.	¼d. inc.
c ,, Wire, basis..	per lb.	6¾d.	6¾d.	..
c Copper Tubes (brazed)	per lb.	8¾d.	8½d.	¼d. inc.
c ,, ,, (solid drawn) ..	per lb.	9¼.	8¾d.	¼d. inc.
g Copper Bars (best selected ..	per ton	£71	£67	£4 inc.
g Copper Sheet	per ton	£71	£67	£4 inc.
g ,, Rod	per ton	£71	£67	£4 inc.
e ,, (Electrolytic) Bars ..	per ton	£60	£59	£1 inc.
e ,, ,, Sheets ..	per ton	£74	£73	£1 inc.
e ,, ,, Rod ..	per ton	£63	£63	..
e ,, ,, H.C. Wire	per lb.	7¼d.	7¼d.	¼d. inc.
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/4½	1/4½	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/5½ to 3/6½	3/6½ to 3/7½	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	47/3½	47/1½	1d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 15	£11 10 to £11 12 6	inc.
g ,, ,, Sheet	per ton	£18	£18	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bott.	£8 12 6	£8 12 6	..
d Mica (in ginal cases) small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee , Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars	per ton	From £15 to £40	From £15 to £40	..
g Tin, Block	per ton	£131 to £135	£131 to £132	£3 inc.
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7½	1/7½	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 10	£23 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons., Ltd. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company Ltd.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	Feb. 6	662	+ 71	36,355	+ 4,434	12¼	13¼
Blackpool and Fleetwood	,, 7	184	+ 36	1,015	+ 132	7¾	7¾
Bristol Trys. & Car. Co.	,, 6	4,278	+ 691	—	—	28	28
British Elec. Trac. Co.:—							
Barnsley District ..	Jan. 30	186	—	634	—	—	—
Devonport	,, 10	357	+ 5	1,592	— 152	5	5
Dudley—Stourbridge..	,, 16	685	+ 88	2,775	+ 191	18¾	18¾
Gateshead	,, 30	816	+219	3,378	+ 659	10½	9½
Gravesend—Northfleet	,, 30	149	—	704	—	2½	—
Greenock—Pt. Glasgow	,, 30	360	+ 61	1,644	+ 116	7¾	7¾
Hartlepool	,, 10	209	+ 54	878	+ 124	6¾	4¾
Kidderminster	,, 30	100	+ 16	408	+ 22	4½	4½
Merthyr	,, 30	162	— 21	672	— 195	8	8
Middleton	,, 30	220	—	959	—	8½	—
Oldham—Ashton ..	,, 30	5 4	+ 96	2,156	+ 194	8	8
Poole	,, 30	221	+ 54	911	+ 129	9¾	9¾
Peterborough	,, 30	175	—	175	—	—	—
Portsmouth	,, 30	1,488	+171	6,213	+ 353	28¾	28¾
Rothesay..	,, 30	32	+ 5	179	+ 43	—	—
B.E.T. Co. (*continued*)—							
Southport	Jan. 30	204	+ 88	873	+ 351	5¾	5¾
South Staffordshire ..	,, 30	660	— 3	2,708	— 351	21¾	23½
Swansea	,, 30	402	+ 21	1,883	+ 78	5½	5½
Taunton	,, 30	47	+ 2	200	— 28	1¼	—
Tynemouth	,, 30	214	+ 50	828	+ 22	3¾	3¾
Weston-super-Mare..	,, 28	21	—	88	—	2¾	—
Wolverhampton Dist.	,, 30	355	+214	1,952	+ 747	10¾	2¾
Central London Railway	Feb. 7	7,198	+502	41,714	+ 2,298	6	6
City and S. London Ry.	,, 8	2,218	+122	20,506	+ 2,038	6½	6½
Doncaster Corp. Trys. ..	—	—	—	—	—	5½	—
Dover Corporation Trys.	,, 7	168	+ 7	941	— 33	3	3
Dublin United Trys. ..	,, 6	4,281	+359	27,182	+ 676	46	46
East Ham Tramways ..	,, 7	509	+236	16,167	+ 3,710	5	4½
Glasgow Corp. Trys. ..	Jan. 24	11,629	+989	415,909	+ 2,201	62	60½
Liverpool Overhead Ry.	Feb. 8	1,600	+355	8,909	+ 707	6¾	6¾
Newcastle Corp. Trys. ..	,, 7	3,018	—	—	—	25	—
Sunderland Corp. Trys.	,, 6	970	+ 55	—	—	17½	17½

* Compared with the corresponding period of 1901.

THE MILLER AUTOMATIC RAILWAY SIGNALS.

On Friday last week, by arrangement with Mr. Sam. Fay, general manager of the Great Central Railway Co., an exhibition of the Miller signalling system was given at the entrance to the Woodhead tunnel, Derbyshire. The function was attended by officials of some 30 railway companies, English and foreign, and representatives of the leading technical journals and newspapers.

As we have stated in another portion of this issue of the Review, there appears to be very little new in the idea, with the exception of using white and red lamps for "clear" and "danger" signals on the cab of the locomotive, and, personally, we doubt whether this will be considered very reliable.

There is apparently a disposition on the part of the British railway companies to adopt some system of automatic track circuit signalling, and, in fact, the South-Western have laid down an installation in the neighbourhood of Salisbury, and the North-Eastern are about to adopt the "Hall system" on a portion of their line.

Apparently the only difference between the systems on these railways and the "Miller system" is that the latter has no visual semaphore signal, which seems a distinct drawback.

Without having had experience of these automatic track circuit systems, it is difficult to give a decided opinion, but we think it is very probable that when the railway companies have experienced a few years' working of the track system, they will be disposed to revert to the ordinary method.

We may say that at the Woodhead Tunnel the distance between the two block cabins at each end of the tunnel is very considerable, and that a lot of time is lost, especially on the "up" journey. Several schemes have been tried to overcome the difficulty; in fact, there is an ordinary intermediate signal cabin in the tunnel, which is used at certain periods of the day.

Considering the state of the rails in Woodhead Tunnel, which at times become quite covered with grease and dirt, it should be a very good test place for the working of a system such as the "Miller system," which, if it would work satisfactorily there, would doubtless work equally well on open lines; but as it happens the track fitted up by the Miller Syndicate is outside the tunnel.

The following description, which was handed to the visitors for their information, is a reprint from the New York *Engineering News* of December 18th, 1902:—

"The well-known Park Avenue tunnel, through which the New York Central and Hudson River Railroad enters the City of New York, has just been fitted with a new system of block signals, in addition to those under which it has been operated hitherto. The new signals, an application of what is known as the Miller system, differ radically from all other railroad signals. They are automatic, and depend upon an electric track circuit, and to this extent they are similar to other automatic signals; the radical novelty of the Miller system lies in the fact that the signals are given directly in the engine cab. Two small electric lamps, one coloured red, the other white, are mounted in the cab within easy view of the engineer. When the train enters a block, one of these two lamps lights up, and remains so until the beginning of the next block is reached. If the track is clear for two blocks ahead—that is, if there is no train or part of a train in either of the two blocks ahead, then the white lamp lights up when the train reaches a block point; if either of the two blocks is occupied, the red lamp lights up. There are no fixed signals, such as semaphores, and the engine runner is guided entirely by the indications of the two little lamps in his cab.

"The following description of the Miller block signals, as exemplified in several different applications, offers material for detailed study of the system on the part of those interested in railway matters. It would seem worth such study if on no better grounds than the novelty of the idea and the ingenuity of the mechanism devised to carry it into practice. Our description is necessarily quite general, and only sufficient to indicate the working of the parts; the drawings presented are complete, however, and will enable the signalling mechanism to be followed out in detail.

"As already stated, the Miller signal-system employs as indicators two lamps, one red, the other white, both being mounted in the cab of the engine. The red and white lamps are carried from a central base-piece, and are surrounded by protecting glass cylinders; spring supports are provided for the ends of the bulbs. Only one of these lamps can be lighted at any one time; the current for their operation is supplied by a battery, or other source of electricity, on the engine, and is switched on to one or the other lamp by an electro-magnetic reversing switch actuated from the track circuit. The lamps, battery and reversing switch constitute the entire train-carried portion of the signal equipment. The remainder of the apparatus is fixed, and may be called the track equipment. It is presupposed that the track is divided into blocks of convenient length (¼ mile to 1 mile), and that at each block point a portion of the track a few rail lengths in extent is insulated from the rest of the track by insulating rail joints. The two rails in each block are utilised to form a track circuit for detecting the presence of a train in the block; a battery is placed across them, and when a train or car is in the block this battery is short-circuited through the wheels and axles.

"The track equipment for the Miller signal comprises a relay instrument at each block station, provided with a battery, and a line wire connecting the different block stations. The function of the relay instrument is to connect the battery to the rail in such a manner as to give the proper signal to the engine when the latter crosses the insulating joint at the rear end of the intermediate track section.

"The arrangement of the apparatus is shown in detail in fig. 1, two consecutive block stations, A and B, being shown. The instruments at A and B are precisely similar. A magnet, *d*, has its coil connected across the rails at the rear end of the block, and when that block is clear the current from the track circuit energises the magnet. The magnet has two armature contacts: one of these, *f*, communicates with the preceding block station through line wire and rail, by way of *m*, *h* and *n*; the other contact, *e*, communicates

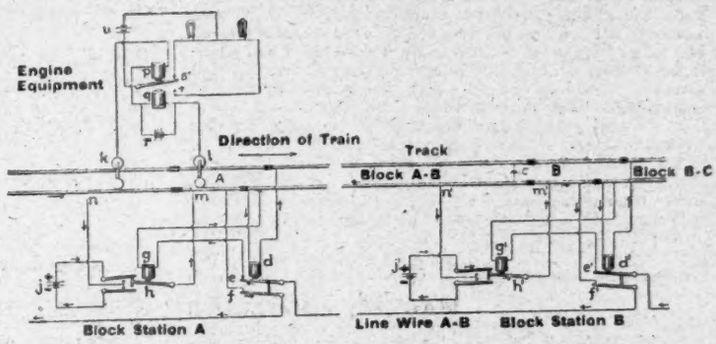


Fig. 1.—General Arrangement of Instruments and Circuits.

with the succeeding block station, by way of line wire and rail, through the coils of a second magnet, *g*. This latter has an armature, *h*, which acts as a reversing switch for battery, *j*, and connects this battery with the points *n* and *m* of the rail, on opposite sides of an insulated joint. When armature *h* is attracted, as it is represented in fig. 1, then the current from *j* tends to flow in the rail from point *m* to point *n*; when *h* is dropped, the current tends to flow from point *n* to point *m*.

"The operation of the relay instrument and its electric circuits may now be readily followed out. When the track A-B is clear, the magnet, *d*, is energised by track battery, *c*, and attracts its armature. Similarly, when block B-C is clear, magnet *d'* at B attracts its armature. We have then an electric circuit as shown, from battery *j'* at B, through *h'* and wire *m'*, through lever *f'* back to instrument A, energising magnet *g*, and back through rail A-B. Armature *h* is then attracted, and an electric pressure is set up

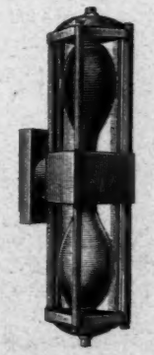


Fig. 2.—Signal Lamp Bracket.

from point *m* to point *n*. When either A-B or B C is occupied, then the circuit through the coils of *g* is broken, at *e* or at *f'*, respectively, and armature *h* drops, so that battery *j* tends to send its current from *n* to *m* through the rail. This pressure between *n* and *m* is utilised by the locomotive equipment to give a signal in the engine cab when the engine crosses the joint between *n* and *m*.

"The engine equipment may have several different forms, one of which is shown above the track in fig. 1. One axle each of engine and tender, *k* and *l*, are insulated from each other,* and are connected through the coils of two magnets, *p* and *q*. The armature which plays between the poles of these magnets is adapted to make contact at *s* or at *t*, completing the circuit of a battery, *u*,

* As now arranged, the engine and tender are insulated from each other at the coupling, not as stated above.

through the white lamp or the red lamp respectively.* When the engine crosses the insulating joint above referred to, the pressure between n and m causes a current to flow through the coils of magnets p and q, and the direction of the current determines whether the armature is attracted up or down, to light the white or the red lamp. When the current flows from k to l, then the armature is attracted downward, lighting the red lamp, and indicating that either block A-B or block B-C is occupied. When both blocks are clear the battery, j, sends current from m to n, or by way of axle l to k, so that the armature is attracted upward and the white lamp lights up.

"It will be noticed that a small battery, r, is arranged on the engine for a local circuit through the coil of magnet, q, in such a way that no polarised armature is required, while at the same time the battery, r, acts to hold the armature in place, either up or down, while passing through the block. When an insulated joint is reached the circuit of r through magnet p by way of the rail back to l is broken, and magnet q being still energised, the armature drops and lights the red lamp. Thus the engine always gets a red signal the moment it passes an insulating joint, unless at the same moment the "clear" impulse from the track relay operates to keep the white lamp alight. In order to avoid this action while crossing the insulating rail joint at the rear end of block A-B, this joint in the two rails is staggered longitudinally a distance of half a rail-length, or at least a distance greater than the interval between axles k and l. As shown in fig. 1, the stagger is less than this, the engine equipment being shown to exaggerated scale, for the sake of clearness; properly, axles k and l should be shown a less distance apart than the stagger of the insulating rail joints."

Great interest was naturally manifested by the railway men present at the experiments, and their general opinion was that while the Miller system was not likely to supersede the ordinary methods of signalling, it might prove a useful auxiliary, and in case of fog or heavy snowstorms enable the driver to see signals which might otherwise be invisible. There are places, such as junctions, where the traffic must be directed by the signals in addition to merely showing a clear line, and in these cases the Miller system would necessarily have to be supplemented by the old-fashioned signalman. To be satisfactory, however, its adoption would require to be universal, because in this country, where so many companies exercise running powers over the lines of other companies, unless every engine using the track was fitted with the Miller apparatus, the semaphore signals must still be maintained.

The advantages claimed for this system of signalling are, briefly, that engine drivers can approach within "vision distance" of an obstruction without incurring danger; the possibility of missing or misreading a signal is done away with, and there is considerable economy in the matter of switch-lights and fog-signals.

A working model can be seen by those interested at the offices of the British Miller Signal Syndicate, Ltd., 9 and 11, Fenchurch Avenue, E.C.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON ELECTRONS.

By Sir Oliver Lodge, F.R.S., Vice-President.

(*Paper read in London, November 27th*, 1902.)

(*Continued from page* 242.)

A little calculation of extreme beauty showed him that the paths of the flying particles under magnetic influence would be *cycloids*, whose generating circles contained the ratio m/e as well as the ratio E/H^2; that is to say their trajectory, if it could be observed, would involve the electro-chemical equivalent required and likewise the ratio of the electric to the magnetic field applied, as well as the absolute strength of the magnetic field.

The calculation is so simple that it may be given here:—

Let the figure (fig. 1) show the zinc and the gauze facing each other, close together, with a gradient of potential $(v - v^1)/d = E$ between them; and let a magnetic field H of induction density be applied normal to the paper.

Then the motion of a charged particle detached and propelled from the origin into the region between the plates, provided that the plates are in vacuum so that there is no resisting medium to interfere, will be—

$$\begin{cases} m\ddot{x} = Ee - He\dot{y} \\ m\ddot{y} = He\dot{x} \end{cases}$$

the initial values of x, y, $\dot{x}$, and $\dot{y}$, being all zero.

The solution of these equations, under these initial conditions, is—

$$\begin{cases} x = a(1 - \cos bt) \\ y = a(bt - \sin bt) \end{cases} \text{ where } a = \frac{E}{H^2}\frac{m}{e} \text{ and } b = H \cdot \frac{e}{m};$$

and from these we see that, whereas x is oscillatory in accordance with a versine, ranging from 0 to $2a$ and back, y is both oscillatory and progressive, completing its period in a time $\frac{2\pi}{b}$, and increasing in every such period by the amount $2\pi a$. In other words, the equations represent a *cycloid* traced by the rim of a circle of radius a rolling on the zinc plate.

There is no known way of actually observing this quite invisible and purely theoretical trajectory; but when it is perceived that in accordance with this theory all the particles moving between the plates will have similar paths, so far as they do not come near the edge of either plate—in which case they would not be propelled so far—it becomes plain that there should be a critical distance within which the gauze would receive and intercept *all* the particles, and beyond which not a single one would be able to reach it. In the figure the gauze is depicted as set just beyond the critical distance, so that it would receive no electricity even though the ultra-violet light were fully shining; but so that if either its distance from the zinc were diminished, or the electric field strengthened, or the magnetic field weakened, the gauze would at once come within range and receive a plentiful supply of charge from the hypothetical cycloidally-flying particles. And the critical distance at which this would happen—a thing easily experimentally observed—would be independent of the brightness of the ultra-violet light, and would be merely the diameter of the generating circle; in other words, the critical distance between the plates, when effective transfer of charge occurred, should be $2a$, or $\frac{2mE}{eH^2}$; a quantity which could by this ingenious means be measured. Wherefore the ratio m/e for this case can be experimentally determined, if E and H are both known. The apparatus employed is shown in fig. 2.

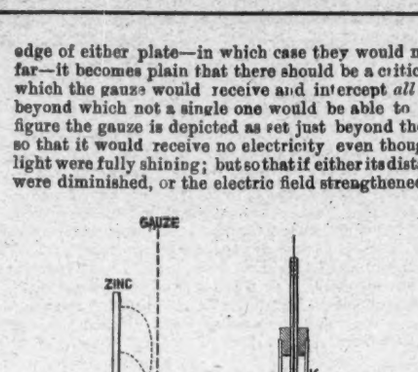


Fig. 1.

Fig. 2.

A B is the insulated zinc plate, C D is the gauze, E F is quartz; the source of ultra-violet light is at some distance below, and the vessel can be filled with any gas and exhausted.

The sharpness of actual experimental observation of the critical distance was not found quite so great as this simple theory would indicate, because of disturbing causes, one of which was the presence of some residual air, interfering with the perfectly free path of the moving bodies; nevertheless it was sharp enough for fair determination; and the result was again, in this case also, that the ratio e/m came out 10^7 c.g.s., or more exactly 7×10^6; corresponding closely with the values found by J. J. Thomson, confirmed subsequently both by Lenard and Kaufmann, for the cathode ray particles.

Another phenomenon on which measurements were made was the discharge of electricity from an incandescent carbon filament in an atmosphere of hydrogen. This also is subject to disturbance by a magnetic field, as was shown by Elster and Geitel; and a series of measurements, on lines similar to the preceding, resulted in a value—$e/m = 8{\cdot}7 \times 10^6$ c.g.s.—a value of the same order of magnitude as before, one thousand times greater than the electro-chemical or electrolytic value for hydrogen, and many thousand times greater than for other substances, but always constant and independent of the nature of the substance present.

The only things which give the ordinary electrolytic value for this ratio are the *positive* carriers. These are not so easy to observe, but Wien* has examined these by detecting and measuring the slight magnetic deflection exhibited by certain rays behind the cathode in a vacuum tube, which Goldstein discovered and called *Kanal-Strahlen*, and which Ewers proved were carriers of positive electricity. Wien has shown that they move slowly, and that in hydrogen their ratio e/m is of the order 10^4, that is to say, the proper value for a hydrogen atom or ion; and with other substances the ratio has been found to vary with the substance and approximately to equal the electrolytic value for these positively charged particles. J. J. Thomson has likewise made measurements on the positive carriers by means of the discharge from incandescent filaments and other positively charged hot bodies, and has confirmed Wien's results.

Thus it is forcibly suggested that whereas the positive carriers of electricity are *ions*, consisting of a unit + charge associated with an atom, the negative carriers appear to be dissociated from the main bulk of the atom, as if they were only fractions or fragments or constituents or appendages of an atom, which, detached and flying loose, are able to attain to prodigious speed; since any acceleration to which they are subjected is a thousand-fold greater than it is even for an atom of hydrogen, weighted down and burdened as that is with a mass of inert material and subject only to the very same propulsive force.

Think of the mobility of a set of particles which experienced the usual gravitation intensity g and had only $\frac{1}{1000}$ of the mass to carry. There is no known way of thus intensifying gravity—there are plenty of ways of diluting it, *e.g.*, Atwood's machine, an inclined plane, &c., &c. But such a mobile particle as that we are now considering would drop under the influence of gravity not 16 ft. in the first second, as everything we know does near the surface of the

* A dynamo and small turbine engine carried on the locomotive was used at Woodhead in lieu of a battery.

* Wied. *Ann.*, LXV., p. 440. See also Ewers in Wied. *Ann.*, LXIX., p. 187.

earth, but 16,000 ft., or about three miles; and would in one second acquire under gravity a velocity of six miles per second, enough almost to carry it out of the range of the earth's attraction altogether, and more than enough to carry it round the world.

The acceleration to which such particles are subject in a vacuum tube is far greater even than this, because there the forces are so prodigious; gravitation force on ions is almost infinitesimal compared with common electrical forces on their charges. Suppose, for instance, that they are in a field such as easily occurs in a vacuum tube, of 3,000 volts per centimetre, $\frac{1}{10}$th of what ordinary air will stand, or 10 electrostatic units. The force urging one of these carriers to move is then $10 \times 10^{-10} = 10^{-9}$ dyne; the mass being moved, if it is a whole atom of hydrogen, *e.g.*, if it were a positive carrier in a hydrogen atmosphere, is only 10^{-24} gramme, and accordingly the acceleration it experiences is 10^{15} centimetres per second per second, or a billion times g. Whereas if it were a negative carrier, in any atmosphere, its acceleration would be a thousand times greater still.

The velocity acquired in passing over a distance of five centimetres under this force is obtained by finding the square root of $2fh$; that is to say, it is 10^8 centimetres per second for a positive carrier, and 3×10^9 centimetres per second for a negative carrier; and these are approximately the orders of magnitude actually observed.

Thus the hypothesis becomes more and more justified that these units of electric charge can separately exist; perhaps carrying with them part of the atom, in which case they might be called corpuscles, having a material nucleus; perhaps pure disembodied electricity, whatever that may be—an electrical charge detached from matter—in which case they would correspond with those hypothetical entities familiar in theoretical and mathematical treatment as "electrons."

APPENDIX TO PART III.

Appendix E.—Electric Saturation, &c.

In my report on Electrolysis to the British Association for 1885 (see the Aberdeen volume, pp. 762, 763), I call attention to the possibility that an atomic theory of electricity would give rise to a maximum charge possible on a given area. The maximum surface density would be attained when every atom was polarised so that its atomic charge faced outwards; and for a solid or liquid it would be very great. For the charge on each being 10^{-10} and the number of atoms per square centimetre being 10^{16}, it follows that the maximum surface density possible is $\sigma = 10^6$ electrostatic units per square centimetre. The corresponding gradient of potential would be $4\pi\sigma = 10^7$, or 3,000 megavolts per centimetre, and the corresponding tension would be $2\pi\sigma^2 = 6 \times 10^{12}$ c.g.s. = 40,000 tons to the square inch. Of course no dielectric would stand this pressure, but absolute vacuum might.

In practice, therefore, it follows that when a surface is charged highly, only an exceedingly small percentage of the molecules are polarised with their charges facing outwards. For instance, common air breaks down when the tension rises to a value $2\pi\sigma^2 = \frac{1}{4}$ gramme per square centimetre = 400 c.g.s.; wherefore the maximum σ in ordinary air is 8 electrostatic units per square centimetre; and this quantity would be afforded by the facing outwards of 10^{11} molecules, or one in every hundred thousand of a solid surface, or about a tenth per cent. of those in air.

It is shown on p. 760 of my 1885 B.A. Report on Electrolysis, that a potential gradient of the order 1 volt over molecular distance is sufficient to overcome atomic attraction and effect decomposition in liquids. Any liquid which is a conductor throws the whole applied stress on to a molecular layer contiguous to an electrode, and accordingly something of the order of a volt or two difference of potential between electrodes in such a liquid is required, and is sufficient, for decomposition.

PART IV.

The Electron Theory of Conduction and of Radiation.

Meanwhile the probability of the existence of electrons and the possibility of regarding them as the basis of all electric and of most other material phenomena had seized hold of the imagination of several mathematical physicists, notably of Dr. J. Larmor and Prof. H. A. Lorentz. Both these philosophers endeavoured to trace all electric properties to the behaviour of electrons, usually, of course, in association with material atoms; and Dr. Larmor proceeded to try and invent a possible structure in the ether which should have the properties of an electron, whether positive or negative, and so reduce a great part of physics to its simplest terms. This magnificent attempt at a new Principia has not yet been finally successful, but a great mass of very suggestive material is to be found in Dr. Larmor's contributions to the *Transactions of the Royal Society*, and in his recent great summary called "Ether and Matter," which last, published by the Cambridge University Press as an Adams Prize Essay, is accessible, though barely intelligible, to all.

Suffice it here to say, that the electron constitutes the basis of the whole treatment, and that there is supposed to be no electric current except electrons in motion. They may move with the atoms, as in electrolysis; they may fly alone, as in gases; or they may be handed on from one fixed atom to the next, as in solids.

Conduction.

The possible modes of conduction or transmission of electricity are in fact three, which I may call respectively the bird-seed method, the bullet method, and the fire-bucket method.

The bird-seed method is adopted in liquids: it is exemplified in electrolysis; the bird carries the seed with it, and only drops it when it reaches an electrode.

The bullet method is the method in gases, as has been clearly realised by aid of the cathode rays: the space from cathode to anode represents the length between the breech and the muzzle of the gun, and the rest of the path is analogous to the trajectory of a bullet, which ultimately either penetrates or is stopped by a target, with a flash of light or other appropriate disturbance.

The fire-bucket method must be the method of conduction in solids, where the atoms are not susceptible of locomotion and can only pass electrons on from hand to hand; oscillating a little in one direction to receive them, and in another direction to deliver them up, and so getting thrown gradually into the state of vibration which we call heat. But it may be observed that this need for motion, in order to pass electrons on, becomes less and less, according as the body is less subject to the irregular molecular disturbance we call heat. It may be the expansion and molecular separation, or it may be the irregular jostling and disturbance that impede easy conduction; but certainly conduction improves as temperature falls, and transmission becomes quite easy at very low temperatures. The conduction of heterogeneous alloys is a less simple matter, being probably mixed up with back E.M.F. developed at innumerable junctions; otherwise, it would be instructive to examine the effect of low temperature on the conductivity of a metal which did not contract with cold. The extra conductivity of hot electrolytes is a totally different phenomenon; it is not true conduction, but convective locomotion of ions in their case.

Metals are bodies in which the transfer of an electron from one atom to another is easy, demanding no force as long as the process is not hurried—a process of the nature of a *diffusion*. Insulators are bodies in which it can only be accomplished with violence. The transmission of vibrations along a chain of connected molecules may well occur through a not dissimilar kind of connection; and hence the conduction of electricity and the conduction of heat, though really different processes, may have many points in common.

Most is known about electrolytic and gaseous conduction. In gaseous conduction the negative electrons fly free and fast; the positive charges travel slowly by reason of their association with matter.

In liquid conduction both sets of electrons are associated with atoms, and travel only as ions at a slow diffusion rate which was calculated by Kohlrausch, has been observed by myself and others, and is well known.

The rate of transmission in solids can only be inferred, and it would appear as if in one class of solids the positive were able to travel fastest, whereas in another class negative travelled fastest: a difference which is familiar in liquids. In acids, for instance, the positive charges travel much the quickest, because they are associated with light hydrogen atoms; and it is owing to the comparatively easy migration of this light or small hydrogen atom that acids are in general such good conductors.

The Hall magnetic bend, like Faraday's magnetic rotation, is a differential effect, and would be zero if positive and negative were equally acted on. In gases it is differential too, but there the negative charges are so free as compared with the positive, and fly so much more rapidly, that the Hall effect in gases, especially in rarified gases, is very great in comparison with the small residual effects found in liquids and solids.

(To be continued.)

PHYSICAL SOCIETY

January 23rd, Prof. S. P. Thompson, President, in the Chair.

A paper "On an Oscillating Table for determining Moments of Inertia" was read by Mr. W. H. Derriman.

A paper entitled "Note on an Elementary Treatment of Conducting Networks" by Prof. L. R. Wilberforce was read by Mr. Derriman. In this paper the author shows that the well-known reciprocal relations between the parts of a conducting network can be readily established without an appeal to the properties of determinants. The fact that there is no continuous accumulation of electricity at any point gives a series of equations of a certain type, and the application of Ohm's law to every branch of the network gives a second series of another type. These equations are written down for two different sets of external currents and internal electromotive forces, and a general equation is obtained from which the ordinary reciprocal relations follow as particular cases.

Mr. T. H. Blakesley said the results were well known and were proved by Maxwell by a more complicated method. He pointed out that if any two conductors in a network are considered, then the rest of the network can be replaced by four suitable resistances joining the ends of the two conductors

A paper "On the Theory of the Quadrant Electrometer" was read by Mr. G. W. Walker. For the purpose of some experiments which the author is taking up, he has found it necessary to examine carefully the theory of a symmetrical quadrant electrometer, and the results of his investigations are put forward in this paper. The late Dr. John Hopkinson pointed out the imperfection of the usual formula given by Maxwell, and also gave an empirical formula which closely represented his experiments. The general result is well known, namely—that the sensibility of the electrometer rises

to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. The author's experiments have been made with a sensitive electrometer by Bartels, of Göttingen, which shows a maximum sensibility when the potential of the needle is about 100 volts. The sensibility seems to go on diminishing after this, at least until very high voltages are used. The formula for a quadrant electrometer is investigated more rigidly than in the text books, and an equation is arrived at which is practically identical with the empirical formula of Hopkinson, and which represents exactly the results obtained by the author from a Bart le' electrometer. The equation contains a constant which must be positive to explain the results, and it is shown that this is the case. An investigation is then undertaken to obtain a numerical value for this constant. The solution of the electrical distribution for a system like the quadrant electrometer is very difficult, but the author discusses and solves a similar two-dimensional problem which confirms his view that the air-gap is sufficient to account for a maximum sensibility depending upon the potential of the needle. The ordinary formula would be more nearly obeyed with a small air-gap. It is pointed out that although diminishing the air-gap raises the potential of maximum sensibility, it does not follow that higher sensibility is obtained by reducing the air-gap. The author then discusses the results obtained by Ayrton and Sumpner from a White electrometer with a bifilar suspension, in which the variation in sensibility is shown to be due to want of symmetry. He states that this effect is not the same as that observed by Hopkinson, and that their experiments probably apply to an extremely unsymmetrical instrument of comparatively low sensibility, and that the maximum considered in this paper is beyond the range of their instrument.

Mr. Addenbrooke stated that he had studied the quadrant electrometer from a practical point of view for many years. He looked upon Hopkinson's paper read before the Physical Society in 1885 as the basis of all work upon the electrometer. Hopkinson pointed out that in a White instrument the deflection was proportional to the potential-difference between the needle and the quadrants up to certain voltages, and ascribed the variations in sensitiveness at high voltages to want of symmetry. Mr. Addenbrooke said that there were many things which might affect the rule that the sensibility was proportional to the potential of the needle. The field is not uniform between the quadrants, the tilting of the needle may be serious, and there may be lateral displacement if the needle is not centrally suspended. In practice the distance between the quadrants must not be too small, and the needle should be as heavy as possible. He thought that the sensitiveness of different electrometers similar to the one used by the author in his experiments would vary considerably. There was always a difficulty with regard to contact-errors when working with very sensitive electrometers, but it was generally possible to get rid of it by balancing. He pointed out how the formula usually employed with a quadrant electrometer could be simplified by arranging so that the potential of one set of quadrants was as much above zero as that of the other set was below.

Mr. Appleyard said that the sensibility of the instrument was increased by doing away with the sulphuric acid and connecting wire. The effect of the surface-tension in the White electrometer was variable and depended among other things upon the strength of the acid.

Dr. A. Griffiths indicated an improved method of arriving, in an elementary manner, at the ordinary formula for the quadrant electrometer by considering the electrical energy per unit volume instead of the capacity per unit length.

The Society then adjourned until February 13th, when the annual general meeting will be held.

CHARACTERISTICS OF ELECTRIC EARTH-CURRENT DISTURBANCES, AND THEIR ORIGIN.

By J. F. Taylor. Communicated to the Royal Society by Sir Oliver Lodge, F.R.S. Read January 22nd, 1903.

This paper deals with disturbing effects produced by rapidly varying earth-currents on a telephone receiver connected in a short line of telegraph having both ends earthed in the sea. The sounds produced have certain well-marked characteristics. In these latitudes they are always stronger and of more frequent occurrence in summer than in winter. They are daily in evidence for a few hours at, or about, the time of sunset, *i.e.*, whilst daylight is fading. In general they do not evidence themselves to any great extent during broad daylight, but are readily precipitated by a state of electrical tension in the atmosphere which may culminate in a thunderstorm, and rarely fail to herald the approach of a storm or gale.

Particularly noticeable among the various types of disturbance enumerated, there are some which resemble the distant scream of a rocket rising in the air. These commence with a shrill whistle and die away in a note of diminishing pitch. They vary in intensity, but always have a similar duration of from two to four seconds; are freely heard at night and only occasionally during the day. The sound is characteristic of an initial high velocity rapidly damped and dissipated. This type of disturbance is assumed to be produced by the passage of meteoric bodies in sufficient proximity to the circuit, which set up rapidly intermittent electrical discharges in the upper regions of the atmosphere, inducing electric currents in the sea which affect the circuit. That they are only occasionally heard during broad daylight is explained by the ionisation of the upper atmosphere by solar radiations, possibly electronic, which interposes a conducting screen. A high state of electrical tension in the atmosphere nullifies or modifies the conductivity produced. At night fall, solar radiations cease to act, and conductivity disappears gradually. The night-fall disturbances are accounted for by aerial electric currents associated with the disappearance of ionic conductivity, the effects of these aerial currents becoming perceptible as soon as the conductivity becomes sufficiently small to act no longer as a screen.

It is suggested that similar causes influence the diurnal variations of the earth's magnetic field, and that the changes of ionisation of the atmosphere offer a reasonable explanation of the greater night-time efficiency in signalling recently observed by Mr. Marconi in experiments with Hertzian wireless telegraphy.

SHIP LIGHTING.

By FRANK BROADBENT, M.I.E.E.

(*Concluded from page* 213.)

It is far better to place all cable connections on the front of the board, even at the risk of somewhat spoiling its appearance. All cables can then be connected up after the board is fixed, and besides the better job that can be made the saving in labour is not inconsiderable.

Wiring.—Here the practice has been to develop "double" wiring in preference to "single." In the main this is the combined result of sentiment and an erroneous idea of what "single" wiring really is. Condemned on theoretical grounds by people in positions of authority having little practical knowledge of up-to-date practice, it is not to be wondered at that shipowners should fight shy of it.

Properly carried out, a good single wired installation, far from being cheap and nasty, is *not* cheaper than a double wired one, but is safer, more mechanical, and costs less for upkeep. The writer's views on the subject were expressed in an article in this journal over 12 years ago,* and after an experience with some 400 odd ship lighting installations, he is still of opinion that there is much to be said in favour of good "single" wiring.

The chief objection urged against the "single"-wire system is that it affects the ship's compasses; but this objection is based principally upon imagination, and very few actual instances of compass deviations due to this system of wiring could be cited. Many single-wired ships actually have their compasses electrically lighted, the wires being inside the compass pedestal, and the lamps placed within a few inches of the needle. These ships sail regularly from this country to India and similarly distant places, yet no compass effects have ever been noted. Of course, such lamps, and all others within 20 or 30 ft. of the compasses, are "double"-wired. In fact, "single" wiring as such is only used in the engine and boiler rooms, where the wires are steel-sheathed, and for the mains to the distributing centres. The whole of the cabin work is practically double-wired on a "single"-wired installation.

Compass deviations are due to a variety of causes, and the electric light is a very convenient scapegoat. It has been the writer's unfortunate experience to make several unpleasant night trips across the Irish Channel in order to investigate compass errors alleged to be due to electric wiring, and in every case it was easily proved that the wiring was not to blame. It is, however, not worth while to pursue this subject, as "single" wiring is rapidly becoming a lost art, and, if carried out by inexperienced people, would most probably give rise to all the ills that are popularly supposed to attach to it.

Distribution.—The ideal system of wiring for ship work is a complete distribution system in which a separate circuit from a sub-distribution board is run for each individual light. There should be absolutely no soldered joints in any

* "Ship Lighting—Single *v.* Double Wiring." May 9th, 1890. pp. 511-512.

cable or wire. A separate circuit for each light may not be possible in every case, or, if possible, might introduce such multiplicity in the wiring as would neutralise to some extent its advantages. Such cases are few, and exist perhaps in large engine rooms, stoke-holds and tunnels, when joints can generally be avoided by looping. The "looping-in" system is by no means a novelty, nor is its usefulness confined to the ceiling roses used in conduit wiring. When it was first used is probably difficult to determine; it has, no doubt, been designed and re-designed by many people during the past 20 years. Some 11 or 12 years of ago, during a railway journey from Stranraer to Newcastle, the writer independently sketched it out, together with a series of "looping-in" fittings suitable for ship lighting work. In these fittings, the back nipple of the lamp, holder is entirely dispensed with, the lampholder tube being screwed directly up to a cast boss in the base of the fitting, leaving an opening for the wires the full width of the porcelain. This design has ever since been a characteristic feature in the ship fittings used by Messrs. J. H. Holmes and Co., one of the pioneer firms in ship lighting work, with whom the writer was then connected.

The separate circuit per lamp method of wiring is somewhat expensive in wire, but all labour in jointing is eliminated, and if the net result be dearer than the ordinary method, the advantages gained are well worth the extra initial outlay.

Cables.—The number of sizes of wires and cables used should be reduced to a minimum. The sub-distribution arrangement permits of this, as only one size—say 3/22—need be used for all branches, and by making each of the main circuits to control approximately the same number of lights, one size of cable can be used for all the principal circuits.

The use of lead-covered wires on board ship is not an unqualified success, and used inside iron pipes—as is occasionally specified—is very bad practice. Even if it survive the drawing-in process, it generally gives trouble sooner or later. Lead-covered wires of large gauge should not be used, either single or in stranded cables. The Admiralty practice of using cables composed of strands of No. 20 S.W.G. wires is one that might advantageously be followed in all ship work when lead-covered cables are used. There is a danger of larger wires piercing the insulation and making contact with the lead, when a cable is sharply bent.

Whilst all bends should be as "easy" as possible, the exigencies of space and position often render sharp bends necessary in cables on board ship, making it highly advisable that the copper conductor should be sufficiently flexible to take the curves without decentralising and cutting into the rubber.

Lead-covered cables should on no account be clipped directly to iron bulkheads or beams, as, although theoretically the iron should suffer, it will be found that the lead in contact with iron, if exposed to the action of sea moisture, will very soon be reduced to a whitish powder, of which lead chloride probably forms a large proportion. To prevent this the lead should be served overall with heavily compounded tape, and to be a really tip-top job, the cable should then be clipped up to teak grounds fixed to the ironwork. In cabin work, where only woodwork is encountered, the tape serving over the lead is unnecessary.

Although uncased lead-covered cables are used exclusively in Admiralty work, they cannot be said to make a very sightly job, and have not met with much favour in cargo or passenger ships. Wood casing is still largely used, and wires are in many cases loosely cleated up behind panels, and run behind neck mouldings.

So long as this is carefully done the neck mouldings being fixed with screws, and the hidden wires behind the panels capable of withdrawal in case of need, little can be urged against the practice. It is a practice, however, that lends itself to scamped work, and under the most favourable conditions, the wires are not really accessible; hence the supervision during erection should be as close as possible.

One very real objection to concealed work on board ship is the risk of damage to the conductors by nails and screws put in by the shipyard joiners who follow up the wiremen's work. This is a prolific source of trouble in such cases, and is conducive to a good deal of extempore and forcible eloquence on the part of the electricians during the trial run. A wire cut through by a nail may test out all right with a galvanometer and battery; it may even survive a trial run of the lights with an occasional flicker; but trouble, sooner or later, is inevitable.

Fittings and Accessories.—In the matter of ship fittings there is a noticeable lack of originality. The designs in common use from 10 to 15 years ago are, with very slight modifications, if any, the stereotyped fittings of to-day. The enamelled iron wash basin, inverted, from which on the least knock the enamel parts company in flakes, still does service as a cargo lantern; the exasperatingly fine screw thread, which is always crossing, or the finely milled nut, is still used to fix the rings or straps of guarded fittings; half-inch nipples and tubes are commonly fitted through which two heavily-insulated wires must be dragged (the looping system is quite impossible under such conditions); and as for the usual run of "watertight" sconce fittings, they would not hold peas, much less keep out water, and very few, indeed, would satisfactorily pass the test of immersion.

The term "crude" is the one that tersely sums up the character of the design of the ordinary run of ship fittings, and the introduction of a little tasteful originality, always keeping in view practical requirements, would be a welcome innovation. There is also a tendency to cut the weight of metal very fine—too fine.

In the matter of double-wire sockets for deck and engine room portables and cargo lanterns there is a real need for something satisfactory.

Such a socket must be suitable for currents up to, say, 10 amperes, and admit of fixing in the open exposed to all weathers. It must hold the plug against the pull of the A.B. seaman, and must be such that the latter can, without instruction, couple-up and uncouple it easily. It must be watertight and coal-dust-tight whether the plug is in or out, and it must be impossible to short-circuit it, except wilfully. The cable terminals or plugs should be so designed that any number of cables can be connected together to form one continuous length, and the method of attachment must be such that the weight of the terminal shall not cause abrasion of the insulation nor breakage of the cable; nor should it be possible for moisture to creep up the braiding to the terminals. These are some of the conditions to be met.

For cabin sockets, the usual type used in house work is much too light in construction, and there is scope for a good design.

As regards switches, owing to the flimsiness of the earlier forms of tumbler switch, this type has for many years been barred for ship installations, the rotary forms being preferred on account of their more mechanical construction. The tumbler type is now, thanks to improvements in design and strength, very generally used for cabin work. There are, however, one or two points of detail to which attention might be directed, points which, in a switch used on land installations, may be quite unobjectionable, are detrimental to switches intended for ship's use.

The use as an insulator of red and white fibre, bone, and other absorbent material may give no trouble in a dry building, but should be entirely absent from non-watertight switches used on a ship. For the same reason, the ever-present moisture, no portion of a switch—that is to say, of the working parts—should be of a rustible metal; but all springs, washers, pivots, &c., should be of brass, copper, or bronze. The use of aluminium in thin sheets is not advisable, although in castings well painted its use may be free from objection. Many tumbler switches are fitted with block terminals having side screws for clamping the wires. In others the screws are set at an angle. Both arrangements are unsuitable for shipwork, and it should be possible to tighten up any screw with a screw-driver at right angles to the face of the switch, or in a line parallel with the motion of the handle. This means that with a switch fixed to a vertical bulkhead or partition—a very usual position—the screws must be get-at-able from the front. This, of course, applies to a wall socket or any other fitting which may be used in a similar position. All terminals should be large enough to receive two conductors so that "looping" may be possible.

The principal points to be kept in view in the design of

fittings or accessories for ship work, are rigidity, damp-proofness and ease of connection. Owing to the risk of damage, fittings, switches, &c., are often not fixed till the wiring is completed, and as time is then limited, everything that tends to rapidity in fixing, and simplicity in connecting up, is an advantage.

METRIC MEASUREMENT.

By ROBERT H. SMITH.

The debate just finished at the Institution of Electrical Engineers showed none of the lassitude that might be supposed natural to this subject at this time of day, but it bore a certain air of unreality. No resolution had been given notice of, and there was no desire to commit the Institution to one view of the question. A list of speakers had been prepared giving the word to each side alternately, and thus the speaking was no gauge of the numerical strength of opinion on one side or the other. What was said was no doubt educative, but no other result bearing towards practical action was aimed at.

Why was this so? Education of the British scientific world on this subject has been going on for a century, and of the British industrial world for at least a quarter of a century; and yet we are not ripe for action! If the strong influence in our Institution had not been well divided, practical reform would be urgently voted at such meetings. Assuredly we British prefer to work along low-tension lines.

Sir Frederick Bramwell is a more skilful advocate than Napoleon I., whom he calls to his aid. Napoleon is perfectly delicious in the memoir translated for us by Sir Frederick. He recognises fully that the great need for uniformity has been felt "throughout the ages." His remedy is "so simple that it could be effected in 24 hours," and this "without effort, without inconvenience, and without coercion," simply by "compelling the executives and the councils" to permit the use of old Paris standards alone. No compulsion at all to use these; only you are not permitted to use any others!

Let us first note some of the smaller points. Sir Frederick, in his character as supreme expert in arithmetic, values highly the "tricks" of calculators, such as 5 lbs. weight per sq. ft. per $\frac{1}{8}$ in. thickness of iron plates. Precisely such a "trick" is the calculation of metric water horse-power by multiplying the flow of water in cb. metre per second by the fall in mm. and dividing by 75; but this same "trick" appears, essentially, in *all* mechanical compound calculations with metric measurements. It is a useful "trick" which saves at least one factor in the calculation; a "trick" at the root and base of the system, and which spreads into its every ramification. How much better to rely upon one universal and all-pervading trick which makes no call upon the memory, but acts automatically, than to use a thousand separate "tricks," each calling for the memorisation of special arbitrary factors! But an iron plate weighs 8 kg. per sq. m. per mm. thickness, and 8 is just as good a "trick" number as $(5 \div \frac{1}{8})$.

Then as to liability to make mistakes by the wrong placing of the decimal point. As a matter of observed fact—observed and guaranteed for by myself among others—mistakes in reading drawings, such as $13\frac{1}{2}$ in. for $1' 3\frac{1}{2}''$ are far more frequent than those from misplacing or misreading the decimal in metric drawings. $13\frac{1}{2}$ in. is not enormously different from $15\frac{1}{2}$ in.; a foreman or a fitter may quite well be excused for not recognising at a glance that $13\frac{1}{2}$ in. is wrong. If a smith and a turner had to produce for a machine, the nature of which they knew, a shaft of $13\frac{1}{2}$ in. diameter, and if the smith wanted to forge it 135 in. diameter, and the turner wanted to turn it to 1·35 in. in diameter, would the works or a lunatic asylum be the better sphere of activity for these arithmetical experts? A mistake from misplacing the decimal point is, in the first place, impossible in the mind of the calculator if he knows and thinks what he is calculating about—that is, if he is a real engineer; and, in the second place, it *cannot* be carried on into practical work, whether that work be in metal in the workshop or in earth and rock in the field. It is too great an enormity. Before it gets two steps in its insane progress it runs up against a practical man who is not a lunatic, and who is not absolutely without knowledge, and who throws it back to its silly originator. Fancy a railway engineer estimating for 880 miles of railway when the map shows only 88 miles length!

Note this important fact, that the frequency and the excusability of the mistake of reading $11\frac{3}{4}$ in. instead of $1' 1\frac{1}{4}''$ on a dirty drawing where many small lines have been rubbed out results altogether from the want of harmony and consistency between our duodecimal sub-division of length units and our decimal numeration. If both were either decimal or duodecimal the mistake would be essentially impossible.

Then Sir Frederick Bramwell defends vulgar fractions as being easy to square, and says that $(4\frac{1}{2})^2 = 4^2 + 8 \times \frac{1}{2} + (\frac{1}{2})^2$, which is a simple amount to find out mentally. But surely it is just as easy to find out $(4{\cdot}3)^2 = 16 + {\cdot}3 \times 8{\cdot}3 = 18{\cdot}49$. It is much easier to calculate mentally $(4{\cdot}37)^2$ than $(4\frac{23}{64})^2$.

Several people say that their own lengthened experience makes them sure that duodecimal fractions are easier and and more rapid to work with than decimal fractions. Irrespective of all question of written numeration this is probably fundamentally true, although those who give this testimony are elderly persons whose calling has led them to spend a lifetime in calculating in yards, feet and inches, while those who have spent a lifetime in calculating in metres and mm. will give an opposite personal testimony.

I, myself, have spent 35 years in almost constant calculation, fairly well divided between British and metric measures, and I have not the smallest hesitation in saying that metric calculation is the easier and quicker. British measures are duodecimal in only a small and irregular degree. A comparison between the metric and a duodecimal *system* would be a very different thing from that between the metric and the British.

To come now to more serious argument, it appears to me that there are only four things to say:—

First, advocates of the metric system should begin by admitting that a duodecimal *system*, if combined with duodecimal written numeration, would be superior. Although duodecimal numeration is richer in simple exact fractions than is decimal, I do not think that that is a serious practical advantge. Those who find duodecimal calculation less annoying and fatiguing than decimal, must set an inordinate and unpractical value upon arithmetic exactitude as distinguished from arithmetic accuracy. An arithmetic *mistake* is unpardonable, but the exactitude required varies as widely as do the innumerable aims of industry. Greater exactitude than is appropriate to the measured data is not only not required; it is injurious and inexcusable. *Per se*, $\frac{5}{16}$ is a fraction not one whit more useful than 0·19, or $\frac{1}{3}$ than ·35. But the circle is easily divided; it almost falls naturally into 12 equal parts. For this reason all primeval and, consequently, all modern astronomy, basing its theories and measurements upon the paper graphic representation of the circle of the heavens, marked off twelfths and twenty-fourths of a complete rotation upon star maps, upon clocks and watches, and upon angle-measuring instruments. For the same reason that the circle is easy of ternary division, elementary geometry delights in equilateral triangles. All men have recognised that it is far more difficult to decimalise the circle than to decimalise anything and everything else in the universe. Not for any richness in simple and uselessly exact fractions in the base 12, but because of the physical nature of the circle, and because there are three dimensions in physical space and four right-angles in one complete revolution, is it clear that humanity suffered an immense and irreparable misfortune when Adam and Eve took to keeping their accounts of the apple harvest in Eden by help of their fingers and toes.

But it is historical fact that they did so, and taught their children and grandchildren to keep accounts in this way, and that all the generations of all the human races in all the quarters of the globe, have continued to do so throughout all the centuries.

It all comes of the two bad habits of gathering apples and counting on the fingers instead of studying astronomy and

triangular geometry; but these vices are as old as the human race, and neither astronomers nor French revolutions, nor British Imperial Duodecimal associations can be effective in purging the $2 \times 10^9 = 8\frac{1}{3} \times 12^8$ inhabitants of this globe of this original sin, and leading us into a new paradise, where we shall write our numbers by powers of 12, and divide our lengths and weights and moneys duodecimally.

The second serious thing to be said is that our system of written numeration must agree with, must be consistent with, must have the same logarithmic base as, our system of sub-divisions and super-multiplications of our units of measurement. All the trouble arises from disagreement between the two. Better have 7 or 13 as a base if we will only stick to it throughout, rather than have disagreement with any other set of mixed bases. The decimal basis of numeration is ineradicable; the French revolutionists would have eradicated it if it had been possible. It is ingrained in the human species, much deeper than race or language; it is common to all calculating living beings; it is the one part of language which is universal; it is the only language which does not change, which neither develops nor withers out. It may be bad, but it is immortal. If all the scientific and industrial and commercial societies in the two hemispheres were banded together to kill it, they could not do it. That is so, and it is a rational necessity to have our numeration and our measures based alike. Therefore our measures must be decimal.

The third serious question is, Which units, metre, inch or foot; kilogramme, lb. or ton? It should be admitted at once that from the purely rational point of view, there is not a pin to choose between them. None of them have any intrinsic superior merit. Any units which have consistent systematic relations among themselves, are quite equally useful. A single unit of each kind of physical quantity is so entirely insufficient for practical purposes as to be useless. In each kind we *must* have several practical units. Putting aside nonsense about terrestrial meridians and seconds-pendulums, Sir John Wolfe Barry says that he finds the metre too large, and that the foot is more convenient for his work; but does he not measure earthwork by cubic yards, and lengths by the 100 ft. chain, and levels by the ·01 of a ft., not the $\frac{1}{12}$th of a foot? Mr. Thos. Parker thinks the inch just the right size for the linear unit. Surely it is easy to recognise that different industries require for their convenience quite different sizes of units. The wire-drawer cannot use inches: he must use mils. The land-surveyor cannot measure areas in square inches; he must have a larger unit. The coal-merchant cannot sell coal by the ounce. It is of no practical physical consequence whatever whether these different sized units are related to each other by ratios of 10, or 12, or 16: it is essential for convenience of calculation that they should be inter-related on the same system as are the grades in our calculating system, that is, our written numeration. So that this inter-relation must be decimal.

Mr. Thos. Parker gives us the most perfect illustration of the folly of opposition to the only existent system of measurement that is consistent and is decimal. He is a man trained in the knowledge of science and in the traditions of reason, and is, therefore, a leading electrical engineer. He, therefore, eagerly advocates uniformitisation and decimalisation. But patriotic fervour and the possession of capital in the form of inch limit gauges and leading screws, attaches him indissolubly to the inch. He, therefore, desires to disseminate from Wolverhamption throughout the civilised world a new set of weights, standardised upon the weight of a cubic inch of water, and a new set of coins; supplanting the foot, yard and mile—that is, three-quarters of the commonly used British linear measures—and all other British measures of every kind, for what purpose? In order simply and solely to arrive at the systematisation and decimalisation already existing in complete development in the metric system, with this one advantage, as it appears to him, of *not* using what is already the common industrial and commercial language of 19 out of the 24 nations which enjoy industrial and commercial civilisation. I have examined Mr. Parker's system carefully, with friendly prejudice in favour of anything proposed by him, and I find that its sole want of novelty lies in the retention of the inch. The inch is the sole link he preserves with past history. All else is protestant and revolutionary alike against British, American and Continental practices. He says emphatically that it is a question of common sense and not of high science; and I wholly agree in this, only common sense seems to me not to lead in this direction.

Lieut.-Col. Crompton is another strong man, whose conviction demands and receives the deepest respect. He has no ill-will against Continental capital sunk in metric limit-gauges and machinery; he wishes to do what is best for the world at large. He says we must not vote by nations or by populations, but by capital value embodied in existing plant, and declares that, according to this criterion, the Continental metric interests must and will give way to Anglo-Saxon interests. There are three remarks to make respecting this, at first sight, very reasonable position. Firstly, if the argument be effective at all, it is effective against all systematisation of measures, even leaving on one side as a subordinate issue the decimalisation of measures. It gives want of system, even wild incoherence, the preference over order and rational *improvement*, and gives dead capital the preference over living intellectual progress.

Secondly, it allows no weight to the fact that the metric capital referred to is of the newest and most improved types. Capital does not live for ever, except, phœnix-like, by dying and giving birth to new. At all times capital dies fast, and renews itself in improved form fast; but the present is an age in which this salutary process is going on much faster than ever before. The Continental metric capital in machinery and plant, which is pitted against the other, is all nearly newborn—a large proportion of it has come into existence only two or three years ago; it has all its life before it, and it is likely to have all the more eager and vigorous life in so far as it has been born a few months too early. A large proportion of the Anglo-Saxon non-metric plant is already near the end of its life, and is, independently of any question of measurement systems, doomed to be soon scrapped. Is it well that the new plant which is taking its place at a rate of probably not much short of 15 to 20 per cent. per annum, should be laid out on the old erratic incomprehensible lines, or upon lines that are clear and simple, and will be, if not forcibly prevented, enduring?

Whether the life of this existing Anglo-Saxon plant is 5, or 10, or 20 years, matters comparatively little. The question of the change from these irrational and time-devouring measurements to the metric system, is not one that ought to be decided with reference to the profits of industry through any short period of years. If the change be made now so that all civilised lands will work together without wasting 30 per cent. of their time in futile attempts to understand each other, it is a change that will quite certainly endure stably for 200 years, and much more probably for 1,000 years. The loss that is inevitably incurred in any change for the better, although to individuals it may be concentrated into very few years, yet to the Anglo-Saxon race as a whole, leaving out of account the rest of the world, can only be considered reasonably as to be distributed as a subtraction from the profits to be realised over many generations, even many centuries.

Again, Mr. Crompton's argument leaves out of sight the new machinery that is being produced, not to replace old, but to fill hitherto empty places. Within the next 50 years there will be laid down in China alone as much new plant as at present exists in England and the United States. Following in the wake of China, Siberia will create a similar, although not so large, new demand. The loss to be endured in order to introduce this change is to be fairly distributed as a deduction from the advantage effected in all this new plant in addition to that replacing worn-out plant.

But once more it is really futile to ignore the right to vote by nationalities, the vote of each, of course, being qualified by the industrial strength of the nation. The industrial pride of each active nation is a fact that must be allowed for. France and Germany have a right to their industrial self-respect as well as we. Against every possible species of race prejudice, Germany took from France a system of industrial calculation which has been one of the great factors in her brilliant progress throughout her new life. Holland has, to its own profit, made the same sacrifice, naturally not so big in material dimensions,

but as intense in respect of patriotic feeling. Japan has shown even more rapid progress, of which she has every reason to be proud, and she also has made the same sacrifice on the altar of international efficiency and goodwill, in spite of her having been for many previous generations fully equipped with a wholly rational, systematised, decimal system of measures and coinage of her own.

Having made these hard sacrifices in order to help towards the attainment of a great international world-wide purpose, is it likely that all these splendidly intellectual and hard-working races will go back upon them merely because the Anglo-Saxon race is bigger than any one of them, taken separately? This is inconceivable, especially if it be remembered that the whole scientific population of the globe is on the side of these other races.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

1,794. "An improved method of making up electrical secondary batteries." F. J. TUBQUAND and J. F. WAKELIN. January 26th.

1,826. "Improvements in automatic electrifying machines." H. KUPFER. January 26th.

1,828. "Improvements in or relating to electric switches." G. THIEL. January 26th. (Complete.)

1,830. "Improvements in or additions to the third rail insulators of electrical railways." BULLERS, LTD., and E. J. CHAMBERS. January 26th.

1,843. "A new or improved electric arc lamp." E. SCHMIDT and A. SCHMIDT, of the firm of E. Leybolds' Nachfolger. January 26th.

1,847. "Improvements in and connected with switches for controlling electric currents." J. E. SPAGNOLETTI. January 26th.

1,848. "An improvement in electrical insulators." J. E. SPAGNOLETTI. January 26th.

1,851. "Improved cord grip for flexible electric conductors and the like." T. W. STOREY. January 26th.

1,855. "Improvements in wireless telegraphy and in apparatus therefor." P. M. JUSTICE. (W. S. Hogg, United States.) January 26th.

1,921. "Improvements in electrical alarm apparatus for use in connection with telegraphic or other lines." H. FONTAINE and J. V. CLEYNENBREUGEL. January 27th. (Complete.)

1,949. "Improvements in surface contact structures for electric railways and tramways." E. A. CAROLAN. (The General Electric Co., United States.) January 27th.

1,964. "Improvements relating to connections for the rails of electric railways, tramways and the like." H. H. LAKE. (P. Azaris, France.) January 27th.

1,980. "Improvements in auxiliary contact devices for electrical switch apparatus." SIEMENS BROS. & Co., LTD. (Siemens & Halske, Aktein-Gesellschaft, Germany.) January 27th.

1,995. "Improvements in or relating to electric lamps of the character known as 'vapour lamps.'" C. O. BASTIAN and A. E. SALISBURY. January 27th

2,030. "Improvements in couplings for metal tubes containing electric wires." J. G. BARBER. January 28th.

2,060. "An improved automatic electric lift gate lock." E. CHAUDOIR and F. G. K. CASTON. January 28th.

2,067. "Improvements in electric controllers." R. W. BROWN. January 28th. (Complete.)

2,162. "Improvements relating to electric ignition apparatus." SIR O. J. LODGE and A. M. LODGE. January 29th.

2,185. "Improvements in electric switch operating mechanism." J. W. MACKENZIE. (R. H. Smith, United States.) January 29th.

2,189. "Improvements in electric switches." E. N. BRAY, F. R. MARKHAM, F. E. REISS and BRAY, MARKHAM and REISS, LTD. January 29th.

2,192. "Improvements in electrically-propelled tramcars." J. S. RAWORTH. January 29th.

2,195. "Improvements in electric accumulators." W. PETO and J. W. T. CADETT. January 29th. (Complete.)

2,198. "Improvements in automatic electric switches." A. G. BLOXAM. (G. Ellison, France.) January 29th.

2,199. "An improved process and apparatus for the treatment of gases, vapours, and the like by electric spark discharges." J. SCHLUTIUS. January 29th. (Complete.)

2,212. "Improvements in and connected with the supporting standards and trolley arms used in overhead electric traction schemes." R. D. ROSS. January 30th.

2,236. "Improvements in and connected with terminals on electrical apparatus." H. OPPENHEIMER. (Actiengesellschaft Mix & Genest, Germany.) January 30th.

2,239. "Improvements relating to electric wiring for lighting and other installations." F. W. BAYLISS and J. R. BROWNE. January 30th.

2,250. "Improved method of jointing electric concentric cables." E. E. PRESTWICH. January 30th.

2,251. "Improvements in electric switches for controlling circuits for lighting, heating, and for other purposes." A. P. LUNDBERG and G. C. LUNDBERG. January 30th. (Complete.)

2,256. "Improvements in or relating to electric distribution systems." A. J. BOULT. (The Osborne-Morgan Co., United States.) January 30th.

2,274. "Improvements in electrical measuring instruments." THE BRITISH THOMSON-HOUSTON Co., LTD., and F. HOLDEN. January 30th.

2,277. "Improvements in arc lamps." W. R. RIDINGS. January 30th.

2,280. "Improvements in and relating to apparatus for perforating paper, for automatic telegraph transmitters and the like." J. GELL. January 30th.

2,284. "Improvements in or relating to starting or regulating gear for electric motors." J. HALL. January 30th.

2,320. "Improved combination case for carrying a watch or the like and means for electrically illuminating the same." J. WILKINS and E. WILKINS. January 31st.

2,337. "Improvements in electric motor-starting or electricity supply switch apparatus." R. G. GRANT, J. F. SIMPSON, and P. C. POPE. January 31st.

2,343. "Improvements in and relating to combined electrical switches and electric magnetic cut-outs." R. W. BILL and F. W. ABBOTT. January 31st.

2,351. "Improvements in the manufacture of insulating material for covering wires for conducting electricity and other purposes." H. MARKUS and E. T. WHITELOW. January 31st.

2,358. "Self-acting switches for meat or overhead rails." J. MARR. January 31st.

2,380. "Improvements in incandescent electric lampholders and the like." J. R. P. LUNN. January 31st.

2,382. "Improvements in electric joint boxes." E. W. MAYNER. January 31st.

2,393. "Improvements in and connected with electrical power systems, especially applicable to railway and tramway vehicles." C. H. R. THORN. January 31st.

2,403. "Improvements in storage battery systems." H. H. LAKE. (C. A. Gould, United States.) January 31st.

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

15,474. "Improvements in systems of telegraphic distribution." P. M. Justice. (Rowland Telegraphic Co.) Dated July 30th, 1901.

15,475. "Improvements in systems of telegraphic inter-communication." P. M. Justice. (Rowland Telegraphic Co.) Dated July 30th, 1901.

15,508. "Improvements in safety devices for overhead electrical circuits." British Thomson-Houston Co. (A. H. Armstrong.) Dated July 31st, 1901.

15,509. "Improvements in electric controllers." British Thomson-Houston Co. (J. B. Linn.) Dated July 31st, 1901.

15,517. "Improvements in or connected with motor controllers for electric railways and the like." British Thomson-Houston Co. (W. B. Potter.) Dated July 31st, 1901.

15,522. "Improved system of wireless telegraphy." V. J. Fenny. (Allgemeine Elektricitäts Gesellschaft, Schiffbauerdamm.) Dated July 31st, 1901.

15,530. "Improvements in or relating to regulating electric currents and to switches therefor." P. Thieme. Dated July 31st, 1901.

15,536. "Improved apparatus for the re-inforcing and standardising of filaments of glow lamps." F. Fanta. Dated July 31st, 1901. (Patent not yet due for sealing).

15,598. "Improvements in printing telegraph machines." A. L. Shepard. Dated August 1st, 1901. (Date applied for under Sec. 103 of Patents, &c., Act, January 3rd, 1883.)

15,671. "Improvements relating to dynamo-electric generators and motors." A. Churchward. Dated August 2nd, 1901.

15,680. "Improvements relating to dynamo-electric generators and motors." A. Churchward. Dated August 2nd, 1901.

15,686. "Improvements relating to commutator brushes for dynamo-electric generators and motors." A. Churchward. Dated August 2nd, 1901.

15,689. "Improvements in electric incandescence lampholders and switches therefor." J. R. Quain. Dated August 2nd, 1901.

15,753. "Improvements in telephone exchanges." F. Stock. Dated August 3rd, 1901.

15,769. "Improvements in the manufacture of incandescing electric lamps." W. Voelker. Dated August 3rd, 1901.

15,801. "Improvements in holders for electric incandescent lamps." H. Hubbell. Dated August 6th, 1901.

15,804. "Improvements in telephone selecting devices." W. D. Watson, J. W. Bolster, F. L. Naylor, G. Davies, E. L. Coryelle and R. A. Berry. Dated August 6th, 1901.

15,816. "Storage batteries and alarms therefor." R. M. Lloyd. Dated August 6th, 1901.

15,817. "Storage battery boxes and jars." R. M. Lloyd. Dated August 6th, 1901.

15,818. "Storage batteries and insulation thereof." R. M. Lloyd. Dated August 6th, 1901.

15,819. "Storage batteries and ventilation thereof." R. M. Lloyd. Dated August 6th, 1901.

15,826. "Improvements in armatures for dynamo-electric machines or motors." J. B. Blood. Dated August 6th, 1901.

15,845. "Improvements in electric fans and motors therefor." E. W. Brown. Dated August 6th, 1901.

15,876. "Improvements in or relating to electrical storage batteries." J. H. West. Dated August 7th, 1901.

15,880. "Improvements in and relating to electro-magnetic controlling apparatus, chiefly for use in connection with surface contact electric railways." British Thomson-Houston Co. (E. M. Hewlett.) Dated August 7th, 1901.

15,881. "Improvements in surface contact electric railways." British Thomson-Houston Co. (W. B. Potter.) Dated August 7th, 1901.

15,882. "Improvements in electric brakes." British Thomson-Houston Co. (D. E. Case.) Dated August 7th, 1901.

15,909. "Improvements in and relating to the electrodes of electrical accumulators." R. W. James. (J. J. Heilmann.) Dated August 7th, 1901.

15,918. "Special method of electrical distribution for traction." C. Marillier. Dated August 7th, 1901.

16,042. "Improved electric quantity meter." O. Imray. (Hartmann and Braun.) Dated August 9th, 1901.

16,121. "Improvements in electricity meters." G. Hookham. Dated August 10th, 1901.

16,123. "Improvements in terminal couplings for electric conductors." T. Jacob. Dated August 10th, 1901.

16,128. "Improvements in electric accumulator batteries." A. Tribelhorn. Dated August 10th, 1901.

16,182. "Improvements in connecting boards for use in junction boxes and the like for multiple electric cables." G. G. M. Hardingham. (E. Waskowsky.) Dated August 12th, 1901.

16,276. "Improvements in electric automobile motors." C. Richter and R. T. Eschler. Dated August 13th, 1901.

16,277. "Improvements in electric traction motors." C. Richter and R. T. Eschler. Dated August 13th, 1901.

16,398. "Portable electric light apparatus for the treatment of lupus." T. Smith. Dated August 15th, 1901.

16,419. "Improvements in frogs, or points and crossings to be used in connection with the conductors of electric tramways and railways." H. G. Nicholson. Dated August 15th, 1901.

16,460. "Improvements in or in connection with electric alternating-current transformers and accessories thereto." G. Wilkinson. Dated August 16th, 1901.

16,506. "Improvements in storage battery plates." A. T. Davies. Dated August 17th, 1901.

16,615. "Improvements in or relating to controlling apparatus for electric motors." A. J. Boult. (N. A. Christensen.) Dated August 19th, 1901.

16,628. "Improvements in mercury or other interrupters for use with induction coils." H. C. Newton. August 19th, 1901.